A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor
FRANK C. WIGHT, Managing Editor

Volume 91 — NEW YORK, NOVEMBER 1, 1923 — Number 18

Light Ahead in Europe

WORLD politics, like a running stream, can be dammed to a certain height. Sooner or later the dam bursts or is overtopped. Last week the European muddle reached the overtopping stage. Whether or not there was more than mere coincidence in the timing of the Baldwin, Harvey and Smuts speeches and the Hughes-Curzon correspondence, it is quite evident that neither Great Britain nor the United States can stand idly by and see a foundation for future wars laid in a dismembered Germany and an international industrial compact between Lorraine iron and Ruhr coal. France is obsessed with her notions of current security and cannot be trusted to foresee the future. The less wounded nations must see ahead for her. If the proposed Hughes conference does nothing else it will at least make public the economic possibilities of the reparations settlement, which have hitherto been obscured by the cloud of international and domestic politics. The economic basis once established the path to agreement and means to insure it will be much easier.

A Unique Personality

CHARLES PROTEUS STEINMETZ was the greatest example in our generation of the triumph of mind over matter. No one who ever saw him will forget that gnomelike figure which had it been clothed in grotesque dress might have stepped out of fairy tale or ancient masque. But the mind was there behind this superficial covering and it carried its possessor to the heights. He was an inspiration to the theorist, because in his chosen line he was the supreme theorist in the world and yet so practical was his theory that for years he remained the technical mainstay of an intensely practical organization. Engineering lost a leader, industry one of its most ardent workers and social science one of its most devoted students when Steinmetz died.

Two Court Decisions

THE courts last week made initial decisions in two cases that have great interest to engineers and the construction industry. In Ohio Judge Sater, in one of the cantonment contract suits, made it clearly evident that the government must specify the exact losses it claims it suffered from the so-called wasteful camp construction during the war. Obscured as it is by the legal distinctions between the agency and the contract relations the camp contractors bore the government, the decision nevertheless indicates that the Department of Justice is to be forced to a more specific definition of the fraud it so vociferously has alleged against the engineers and contractors who helped win the war at the cantonment sites. The other case was the decision of Judge Knox in New York City that the Eastern open-price cement manufacturers association is a combination in restraint of trade and therefore illegal. In view of the earlier decisions in the hardwood and tile case this one was to be expected. It is interesting to note, however, that Judge Knox is by no means convinced that the price and contract interchange methods under attack resulted in an exorbitant price of cement, and this, as we have pointed out before, is the question that engineers and contractors want most to have settled.

A Remarkable Runoff Record

NO BETTER example of the vagaries of rainfall and its consequent runoff could be found than the experience of Oklahoma City this summer. A river which had been dammed for water supply had a record flow up to May of this year of 11,000 sec.ft. In that month this was surpassed by 1,000 ft., not at all surprising considering the relatively short period over which the records of flow in this comparatively new country extend. But in the six months thereafter there were three successive floods, first 33,000 sec.ft., then 12,000 sec.ft. and now the last one, described in this issue, of 60,000 sec.ft. This is breaking records with a vengeance. Full data regarding the last remarkable runoff will be looked for by all interested in water storage and control.

Function of Contracting

SUBCONTRACTING perhaps receives its most complete modern expression in building construction. Years ago when railway construction was at its peak it might have claimed precedence as being most practiced in the multiplication of contracts. Then, on occasion, the subcontractor sublet parts of his contract and the sub-subcontractors relet their work to station men. Out of modern building practice has grown, as there once grew out of railway construction, a class of contractors who are more financiers and co-ordinators of construction operations than they are actual constructors. The reaction is a demand by some of the building trades that separate contracts be awarded them for the work for which ordinarily, now, they must seek subcontracts. A specific instance is the memorial to the Interdepartmental Board of Contracts and Adjustments urging separate contracts for the "mechanical elements," of federal buildings. Neither the claim nor the argument against it need concern us at this time. It will be noted merely that building construction practice furnishes a particularly clear illustration of a function of contracting that is commonly overlooked; this function is management of construction. In brief, contrary to common acceptance, the most important function of the general contractor is not to erect steel or brick or concrete, but to co-ordinate and synchronize construction operations and to assume responsibility for the owner. The contractor does not merely construct; he

furnishes a management and financing service and an insurance against risk. If we keep these truths clear, that if the contractor does not perform these functions there must be some other agency employed, we shall escape many of the false conclusions about cheapening construction by eliminating contractors' profits.

Why Not a Construction Show?

AN ENGINEERING and business congress of highway industries, which has true magnitude, has been developed around the annual meeting of the American Road Builders' Association. In Chicago in January each year the exhibition of road building materials and machines and the technical proceedings of the road builders' convention represent about the highest effort that has been attained in gathering together for business and education all the elements of a leading activity in the construction world. Because it is outstanding, indeed almost alone, as a construction exhibition, the road show draws visitors from all lines of the construction industry. The circumstance suggests the thought of the creation of a general construction-industries exhibition around which the associations of that industry can arrange their annual business and technical conventions. Is the idea practical? One sees no convincing reasons why it is not. Truly there are visible difficulties of exhibition space, hotel accommodations and convention scheduling, but they appear small when set against the time and money saved by exhibitors and visitors. The present road show is a nucleus to grow around. Contractors particularly would like to see it become, by extension of time, space and exhibits, a construction show. Indeed it is with this possibility in mind that this year the Associated General Contractors are entering partly into joint convention work with the American Road Builders Association. Why not a single annual construction show with a tributary business and technical congress of construction associations?

When to Use a Trestle

RECENT floods in the Middle West, notably those with which the Burlington Ry. has been afflicted, call attention again to the importance of the timber trestle in railway construction. An expedient of the early days of railroading, the trestle remains a necessary structure at many locations where economy is governing. But in the "cloudburst" country where a dry run may be converted once a year into a raging torrent the trestle is a dangerous element in operation. It may be questioned whether the use of the trestle has not been carried to extremes by perfunctory adoption of this type, with low cost as the primary consideration and with insufficient study of its suitability for such use. If in the engineer's judgment the trestle is the proper type of structure to be adopted he should give careful attention not only to substantial design of its superstructure but especially to its foundations and abutments. A guiding rule to be followed as far as conditions may permit or warrant in each particular case is contained in the following statement quoted from *Engineering News*, Sept. 29, 1910, p. 337: "Occasional washouts of trestles crossing small creeks or dry runs direct attention to trestle piling. Every year several failures of this class occur, and though not all produce train wrecks yet several of the worst wrecks of the last decade were due to such failures. It is fair to conclude that in planning structures in the territory from the Missouri River to the Coast a dry run should always be regarded as a bank-full torrent. Since these ravines usually have a steep slope they offer the possibility of great scouring power, so that foundations of the most resistant type should be provided."

Protecting Trains From Washouts

THE failure of the Cole Creek trestle on the Burlington some weeks ago draws attention to the problem of the protection of trains in case of a washout. Automatic warning signals to indicate damage or destruction of trestles by fire and flood have been suggested and even tried experimentally. But the operation of such devices depends usually upon the movement or failure of some part of the structure. It is not unlikely that in many cases all parts may remain intact, though undermined, until the weight of a train causes collapse. Furthermore, the chances are against the reliability and observance of a signal or a series of signals at small structures where floods are infrequent and where the signal might remain unoperated for long periods. Automatic block signals with track circuits would afford little protection except in case of complete washout, since the track is usually the last part to fail. Inspection at low water may show a safe and stable structure, but when the water has risen and a torrent is flowing it is difficult to determine conditions of scour or undermining, while as a rule the bridges are too numerous and the storms too sudden to permit of thorough investigation at the critical time. With sudden storms the engineman may have no warning of conditions ahead of him. The structures may show him no sign of weakness and at night or in stormy weather he probably would not notice every small trestle. The problem, in fact, has not been satisfactorily solved.

Transverse Fissures in Steel Rails

NO MORE serious problem has ever confronted the rail manufacturers and users than that of preventing failures due to transverse fissures, a peculiarly dangerous type of failure because of the fact that it almost invariably occurs before the fissure reaches the surface of the rail. The transverse fissure as a specific type of rail failure was recognized twelve years ago during the investigation by the Interstate Commerce Commission of a serious railroad accident at Manchester, N. Y. Twelve years of study have not brought us much nearer determining the cause of this baffling type of failure. Instead, we are faced with an ever-increasing number of rail failures from this cause and a mass of contradictory evidence as to the cause.

But the rail users have been fortunate in one respect, for the man who first recognized the transverse fissure, the engineer-physicist of the Interstate Commerce Commission, has continued in that capacity and has persisted in the study which he started twelve years ago. From time to time during the past twelve years he has issued reports of his progress. The latest one, prepared some months ago, is abstracted elsewhere in this issue. In this report he brings forth more evidence to substantiate the theory which he has held for some years, as to the cause of transverse fissures, namely, that transverse fissures are caused and developed from their incipiency by the cold rolling action of the car wheels.

Most of the evidence does indeed favor this theory, but in view of some of the contradictory evidence it is

difficult to accept it absolutely. A safer position would be to consider the cold rolling as the cause of the development of the fissures from their incipiency, and the cause of the incipient fissure still undetermined. Two features of the evidence, brought out in this latest report more clearly than ever before, lead to this belief. The first is that certain heats are more subject to transverse fissures than others, and the second that rails rolled by certain mills in certain years are more subject to transverse fissures than rails rolled in other years or by other mills when laid in the same track. So convinced are some railroad officials that certain rollings or certain heats are superior to others that they remove all the rails of any heat from the track when the second failure occurs in that heat, and in some cases whole stretches of rail rolled in certain years have been removed from the track when still otherwise serviceable because of repeated failures by transverse fissures.

Another curious, though possibly unimportant, feature of the situation is the grouping of transverse fissures at certain geographical locations. Probably the increasing ability on the part of section foremen to recognize a transverse fissure and more knowledge of the conditions contributing to their development will eliminate this feature.

Undoubtedly the cold rolling of the rails under heavy axle loads used in this country has developed the transverse fissures from its incipiency to ultimate failure, but as long as rails of the same section but of different manufacture or even different heats continue to give different results under the same traffic we are convinced that the *cause* will be found in some defect in the manufacture of the rail.

For a Federal Contract Law

AFTER some eighteen months' work, and the time taken has been no longer than the task required, a standard form of building and construction contract has been tentatively adopted by the Interdepartmental Board of Contracts and Adjustments. This contract is now before the construction industry for discussion and constructive criticism. Many changes both in fundamental practice and in technical details have already been suggested. Consideration of these changes need not occupy us. They will be adopted or disregarded as the board decides and a final contract form will be approved. This is the thing of substantial importance in all the work which has been done and is to come: a standard construction contract for federal public works is immediately ahead. There should follow a general federal contract law.

It is not possible here to consider the reasons, either political or technical, which stimulated present legislation governing federal contracts. Let us consider merely the number of laws which are the accumulation of years of legislation. In a compilation made by the board there are listed 224 separate statutes. Of these 40 apply to all government departments, 12 apply to two or more departments and 172 apply to only one department. Incidentally the proposed standard contract of necessity complies with all these laws. Herein has rested much of the difficulty in drafting it. It may be the reason why in making the final draft suggested revisions will not be made.

Law controls government contract procedure. It is important to hold this fact in mind. The government is an abstract entity. It expresses itself concretely in contractual relations only by the statutes affecting contracts. It speaks and acts only through agents who can take no action that does not express the law. And the law is 224 separate statutes. All the forms of contracts of all the federal departments, which it is the purpose of the standard form to eliminate, are not a tithe as many. If a general contract form is needed. then, a general contract law is more needed.

Such a general act is contemplated by the board. In brief this act will repeal all conflicting and obsolete statutes and make uniform all provisions in one short law. If the board follows its procedure in drafting the standard contract form to invite aid in arriving at decisions from the whole construction industry, engineers and contractors can play a useful part in formulating the general federal contract law. There are few employers of which they have more loudly complained in the past. Let them be as ready to help put away the causes of complaint.

Arkansas Roads Redivivus

ARKANSAS has placed itself squarely in the roster of states having state highway systems and centralized direction of highway improvement. It is no longer the incorrigible member of the family of road building commonwealths. Uncle Sam can again let it share in federal aid which it alone of all 48 states has been denied during the year. Although the highway world will be a duller place lacking the southern state's fiery assaults on sundry and all who have ventured an intruding finger into its ways of managing its public roads, the change will be altogether good for Arkansas highway affairs.

Briefly a state highway law has been enacted. It creates a highway commission, establishes a system of state roads and provides a fund for constructing and maintaining these roads. Part of the funds raised will pay old road-district debts. No more road-improvement districts can be created and no more road-district bonds may be issued except under close restrictions. These provisions remove the cause of most of the highway tribulations which the state has suffered in the past. Motor vehicle owners wil provide the money. There is a 4c. tax on gasoline, the highest gasoline tax in any state. Motor oil is taxed 10c., and license fees are virtually doubled. The new highway commission has true responsibility and real authority. Altogether Arkansas has a commendable road law. By its honest enforcement most of the past errors in highway management can be redeemed.

In recording this advance it is due Arkansas to remember that its errors in highway improvement have been faults of understanding rather than of enterprise. There are few states in the Union which have in the last five years shown a more determined spirit in lifting their highways out of the mud. The people have voted $60,000,000 of bonds for road building and there are completed some 28,700 miles of improved road of which 3,871 miles are surfaced or paved roads. These are accomplishments which stand out even in comparison with the road building of the states of the North. Arkansas may well feel proud of its high enterprise in road building. That it has frequenty been so greatly misdirected is a reason for regret. Uncontrolled local management of road improvement has no blacker page in its records.

Hollow Dam with Notable Design Features

Storage Dam at Cisco, Texas, Has Cutoff Wall Integral with Deck—Corrugated Footings Resist Sliding —Four-Mile Railway Constructed—Forms for Deck Used Thirty Times

BY FRANK W. CHAPPELL
Elrod Engineering Co., Dallas, Tex.
AND
E. M. URBAN
H. F. Friestedt Co., Contractors, Chicago, Ill.

DAM BUILDING of unusual magnitude for so small a city is just drawing to a close at Cisco, Tex., as an insurance against drought and fire. Rainfall is uncertain in west-central Texas, where Cisco is located, and droughts are frequent and, sometimes, of long duration. Storage is the only safeguard against water famine and so the Cisco dam is being built to form a reservoir of some 30,000 acre-feet capacity on Sandy Creek about four miles north of the city. This dam presents interesting practice, both in design and construction, which deserves mention.

Design and Structure

BY FRANK W. CHAPPELL

About 1,000 acres are contained in the Cisco reservoir, which has an average depth of 30 ft. and a maximum depth of 85 ft., and is formed by a hollow, reinforced-concrete dam 85 ft. high. Figs. 1, 2 and 3 give the essential dimensions and show the general structure.

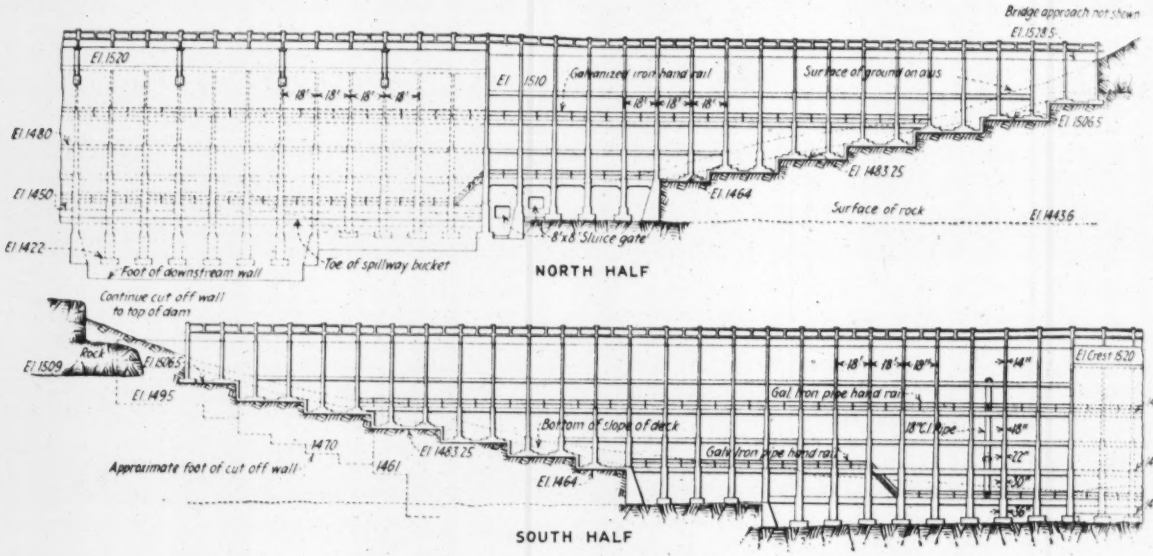


FIG. 1—DOWNSTREAM ELEVATION OF CISCO DAM

Underlying the dam are various sorts of clays, shale and thin limestone ledges. The lowest footings, as shown by Fig. 1, are in hard blue shale at El. 1,420, or about 15 ft. below the creek bed. Twenty-seven buttresses rest on limestone ledges at or about El. 1,435 and 1,445. This stratum varies in thickness from 3 to 6 ft., and is hard and fissured. Under it is hard clay and shale so its bearing power is satisfactory for any reasonable load. The 13 buttresses on each end of the dam have footings on clay. Of these formations only the limestone would allow the passage of water; all the clay and shale is dense, homogeneous and quite impervious.

Substructure—All footings, excepting those on clay, are simple, separate, unreinforced concrete slabs. The greatest pressure on any part of the rock foundation, including hard shale, will be 7 tons per square foot. Where steps are required from one foundation material to another, the footing becomes a gravity section retaining wall. It is necessary to provide positive support for the adjacent clay walls, even though these might be covered with stone or concrete.

Buttresses supported on clay have footings of a rather unusual design. Reinforced-concrete mats carrying two buttresses each, Fig. 1, are arranged in two series, one on each side of the valley. A thin reinforced slab, built with the upper step and anchored behind the lower one, retains the foundation clay and protects it from disintegration. These footings are being covered with earth as the dam is completed to such heights as to give drainage away from the dam.

This footing arrangement is clearly indicated by Fig. 1. As shown by Figs. 2 and 3, a cutoff wall of varying depth and thickness extends from end to end of the dam and into the abutting hills. It is reinforced throughout and doweled into the footings and the deck. Its greatest depth is 55 ft. below the natural ground surface. Contrary to the practice, established on some dams of similar type, of making the cutoff wall a thin, unreinforced section, this part of the Cisco dam is regarded as a vital part of the structure and it was designed as a continuation of the deck and is being built with equal care and attention to detail.

Its deficiency in resistance to sliding is the most serious weakness of the hollow type concrete dam. Three types of anchorage were adopted.

On the clay foundation bed there were poured heavy ribs of plain concrete in trenches dug parallel to the axis of the dam, the ribs being monolithic with the footing slab. Fig. 4 indicates this saw-tooth construction, and also how the cutoff walls were reinforced and tied to both the footing and the deck slabs.

No artificial roughening could be attempted on the thin limestone ledges. They were considered as being

as good merely as so much plain concrete of ordinary quality and only their weight was utilized. While the surface is somewhat wave-worn and fissured it is smooth in comparison to the areas involved. For safety it was taken as being perfectly smooth and the coefficient of friction as that for concrete on limestone. The deficiency was made up by inserting steel dowels at an angle of 45 deg., or practically parallel to the deck.

Buttresses resting on the thick mass of shale at El. 1,420 were anchored against sliding by simply

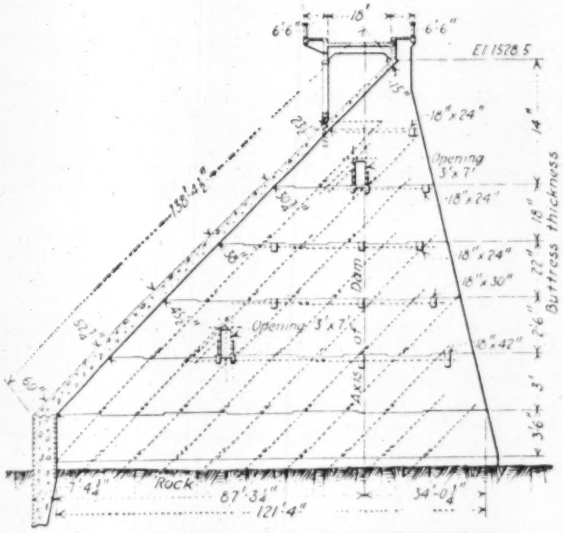


FIG. 2—BULKHEAD SECTION OF CISCO DAM

blasting out cavities under the footings. These were filled with concrete, poured monolithic with the footings.

Superstructure—The buttress thicknesses are so proportioned that the greatest shearing stress in a horizontal plane will be 100 lb. per square inch. Some steel was inserted parallel to the deck to counterbalance defects in construction joints. Beams and slabs were designed for a compressive stress in concrete of 600 lb. per square inch, and steel in tension, 16,000 lb. per square inch. In proportioning and reinforcing the deck slab, all shear up to 50 lb. per square inch was assumed as being taken by concrete. Horizontal reinforcement is bent up to assume the excess of shearing stress above 50 lb. This design introduces into the lower reaches of the slab more horizontal steel than is required for tension, but this is unavoidable unless stirrups are used.

The deck is being poured in continuous sections of 72 ft., making each panel to extend over four buttress spans. Unusual care is being taken to make the slab watertight at expansion joints (Fig. 5). U-shaped strips of No. 11 copper, which have flanges cast into adjoining sections, allow of expansion without leakage. The slabs are separated by "elastite" strips placed against the face of the one first poured. Longitudinal construction joints are made with double keys and the surface of the previous day's work is cleaned and washed. Each section of deck is poured from top to bottom with the shortest possible intervals between the placing of successive batches. The engineers and the contractor considered the advisability of continuous pouring for each section of deck and concluded that the advantages were not sufficient to offset the uncertain quality of night work.

All concrete, except that in heavy retaining walls, is of a 1:2:4 mix; retaining walls are of 1:3:6 mix. Coarse aggregate consists of crushed local limestone, ¼ to 2½ in. Fine aggregate is creek sand up to ¼-in. particles. The first concrete poured was mixed with crusher screenings as sand. No means were provided for removing dust and 16 per cent of the screenings passed a 200-mesh sieve. The resulting mortar was high in strength, 1:3 briquettes showing 25 per cent higher tensile strength than the same mix of standard Ottawa sand. A great deal of trouble, however, was experienced with a heavy layer of laitance on each buttress lift. The fear that some of this chalky material might be left in the structure, together with the possibility of the dissolution of minute, uncoated particles under long submergence, led to the abandonment of screenings as sand.

Spillway Design—The area of lands draining into the reservoir is 30 square miles. The country is rugged, sparsely settled and covered with growths of black jack oak and mesquite. The reservoir banks are generally precipitous and there is little cultivated land on the watershed. No records of stream flow have been kept and an attempt was made to collect testimony of persons living in the neighborhood, for determining flood flow. This was found to be conflicting and uncertain.

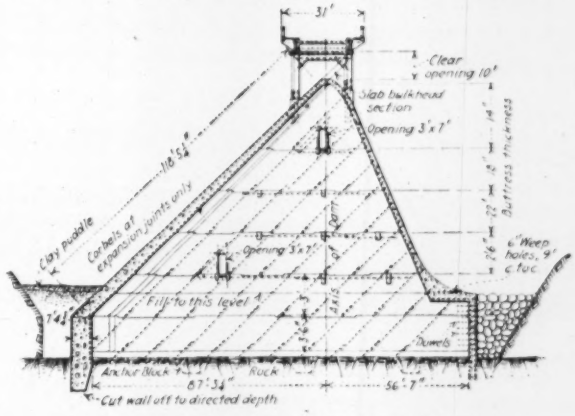


FIG. 3—SPILLWAY SECTION OF CISCO DAM

Calculations based on highwater marks designated by different individuals indicated a discharge varying from 8,000 to 15,000 sec.-ft.

In view of the excessive floods noted in various parts of Texas during the past, it was thought best to disregard all of the data collected on this particular stream as being incomplete and unreliable. Although it is extremely improbable that any intense tropical storm will ever break as far inland as Cisco, the total discharge capacity through and over the dam was made 36,000 sec.-ft., or 1,200 sec.-ft. per square mile.

Flood waters will be disposed of over a spillway 270 ft. long by 10 ft. deep and through two sluice gates. Since the greatest flood to be expected, excepting those great cloudbursts at intervals of fifty years or more, will be less than half the total discharge capacity, the spillway crest was designed for a 5-ft. depth of flow. The short duration of extraordinary stages makes it uneconomical and unnecessary to widen the crest to accommodate them. In addition the wide crest would form a broad-crested wier for low heads, with less discharge capacity than the sharper section and for local reasons it is desired to hold the fluctuations of water-level within

the lowest possible limits. The spillway apron will have a uniform thickness of 20 in. The discharge will be partly upon a limestone ledge and partly over the shale. In the latter case the apron is extended vertically for a distance of 10 ft. into the shale.

Two sluice gates, each having a clear opening 8 ft. square will be installed just north of the spillway. They will be electrically operated with remote control switches from the pump station or from the hilltop at the south end of the dam, at the pleasure of the operator. As above explained the sluice gates have been included in providing for the discharge of the creek. But in addition to this consideration, they are deemed necessary as emergency outlets.

Quantities and Cost—The estimated quantities are: concrete 43,000 cu.yd.; steel, 1,000 tons; excavation, 95,000 cu.yd., and copper, 25,000 lb. A pumping station will be built within the dam, between buttresses 25 and 26, and a filtration plant will be built on the hillside below the dam. The total cost of the project will be approximately $1,300,000.

The Elrod Engineering Co. of Dallas are consulting engineers for the city of Cisco, and prepared all plans for the dam and supervised its construction. The writer acted as chief designing engineer, and is responsible for the details. T. A. Hodges and J. G. Reagan have been resident engineers in charge of construction. The general contractor is the H. F. Friestedt Co. of Chicago.

Construction Plant and Methods

BY E. M. URBAN

Transportation was the primary problem in building the Cisco dam. The site was in an eroded and broken district four miles from the railway and there was no passable road to it. A railway was the first requirement, and it had to be built in a rough, rocky canyon following the meandering course of a small stream which it crossed three times on wooden bridges. This short railway was the sole means of transporting first the construction plant units and, then, all of the materials used in the construction of the dam. Over 1,000 tons of reinforcing steel, 600,000 ft. b.m. of lumber, 21,500 cu.yd. of sand, 43,000 cu.yd. of crushed stone and many carloads of miscellaneous supplies and materials were hauled over this road.

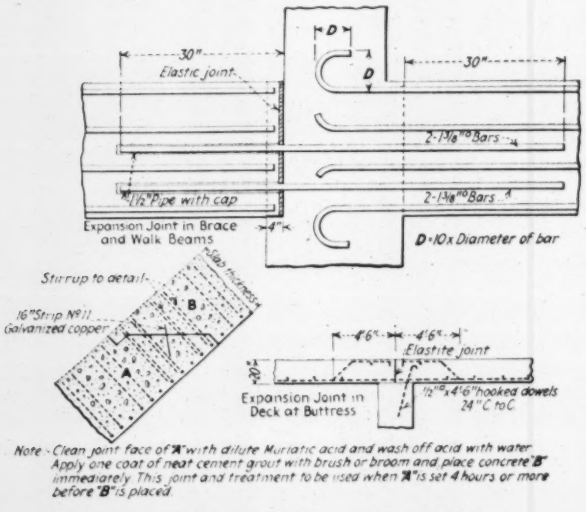

30"
Elastic joint
D
30"
2-1⅜"ø Bars
1½"Pipe with cap
2-1⅜"ø Bars
Expansion Joint in Brace and Walk Beams
4"
D+10x Diameter of bar
Stirrup to detail
Slab thickness
16"Strip №11 Galvanized copper
A
B
4'6"
4'6"
Elastite joint
Expansion Joint in Deck at Buttress
½"ø x 4'6" hooked dowels 24" C. to C.
Note - Clean joint face of "A" with dilute Muriatic acid and wash off acid with water. Apply one coat of neat cement grout with brush or broom and place concrete "B" immediately. This joint and treatment to be used when "A" is set 4 hours or more before "B" is placed.

FIG. 5—DETAILS OF EXPANSION JOINTS

Plant Layout—As the line of the railway was downstream to the dam it was necessary to locate the plant on the upstream side. A very simple and convenient arrangement, as shown by Fig. 6, was practicable. The

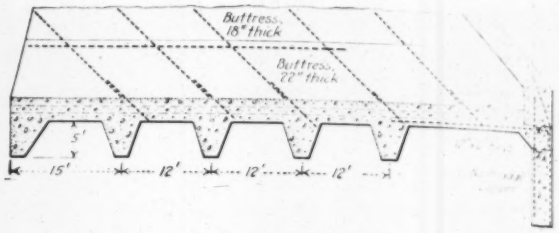


FIG. 4—SECTIONAL ELEVATION OF BUTTRESS FOOTING ON CLAY

plant consisted of a 300-ton gyratory crushing unit, a 400-cu.yd. concrete mixing unit, a sawmill for heavy cutting, an engine house with one 50-hp. engine and a 75-hp. electric hoist, a machine shop, and a 40-hp. gas engine to operate rigging and an overhead cableway. The rock crushing and concrete mixing units were operated by electric motors and the bucket in No. 2 tower was handled by the electric hoist. Distribution of concrete was by towers and chutes. Two towers were required to chute to all parts of the dam, one at the mixing plant 160 ft. high and one on the dam 140 ft. high above the dam top. Fig. 7 is a view of the dam showing the towers. With this tower and chute system, concrete was delivered 500 ft. at the rate of a yard a minute.

Excavation and Handling Material—The excavation was chiefly difficult because a great portion consisted of trenches in clay, shale and rock and had to be done by hand. In the deep trenches bracing had to be handled with care. The bulk excavation was performed by steam shovels and trains with some slip and Fresno scraper work.

All materials were brought to the dam over the construction railway down the canyon and were stored in yards, bins and sheds as indicated by Fig. 6. After the lumber was framed it was carried to the foot of the dam and then set in place by the overhead cableway. The reinforcing units were fabricated in the yard and

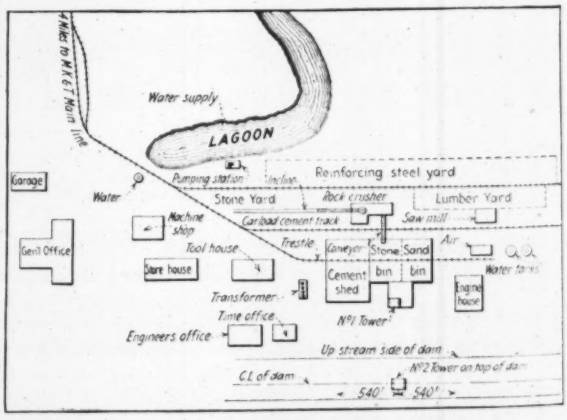


FIG. 6—GENERAL ARRANGEMENT OF CONSTRUCTION PLANT

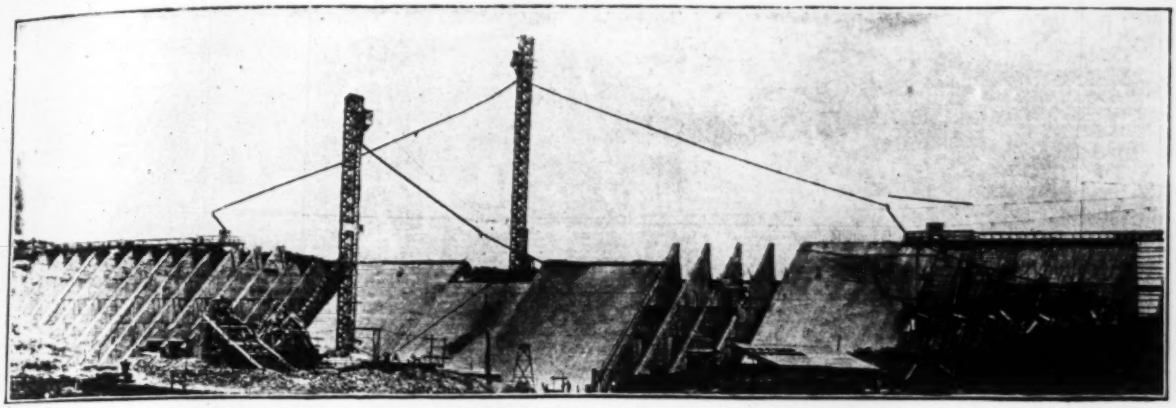


FIG. 7—DAM UNDER CONSTRUCTION SHOWING CONCRETE DISTRIBUTING TOWERS

then handled as was the form lumber. Cement was chuted from the cars directly into a 2,200-bbl. cement house. All carloads of sand and crushed stone were unloaded by a clamshell derrick near the connection of the construction railway with the M.-K.-T. R.R., and then loaded into 16-cu.yd. dump cars which unloaded into the bins of the mixing plant. Most of the crushed stone, however, was quarried within a mile or two of the work and teamed to the crusher plant shown by Fig. 6.

Form Construction—Beams and buttresses being alike, forms were built in sections or panels. They were 2 x 8-in. sheathing on 4 x 6-in. timbers spaced 2 ft. on centers. The panels were tied together through the concrete by tie rods and form clamps. These panels were used from 20 to 30 times and some of them lasted through the construction work. The serious problem was the design and handling of the form panels for the deck slab face.

As shown by the plans (Fig. 1) the dam buttresses

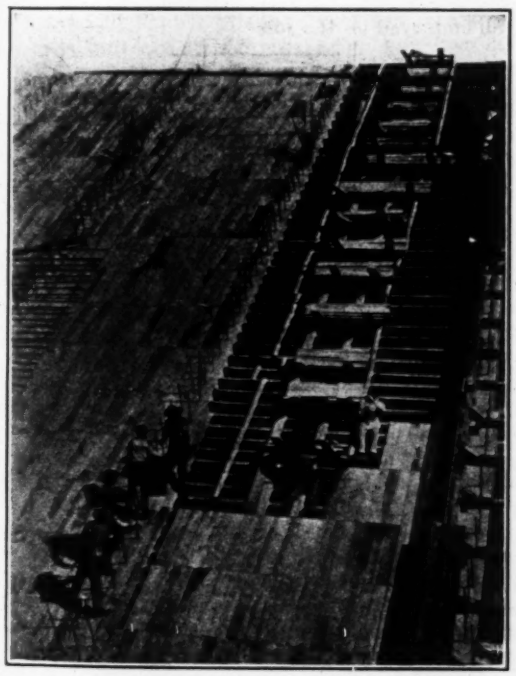


FIG. 9—SHEATHING FORM FOR BACK OF DECK SLAB

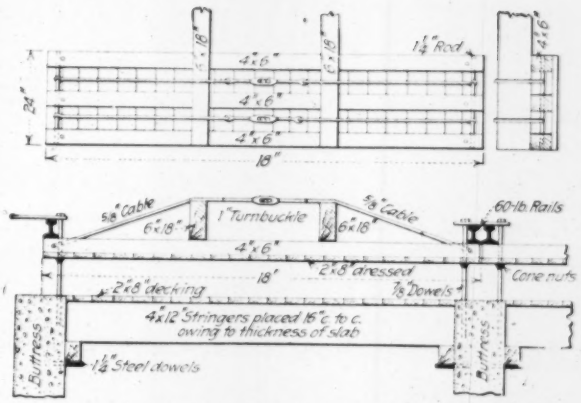


FIG. 8—DETAILS OF DECK SLAB FACE FORM PANELS

were 18 ft. apart on centers. The expansion joints in the deck slab were 72 ft. apart, or over every fourth buttress, and the deck was required to be concreted in a succession of lifts continuous between expansion joints. As shown by Fig. 8 and the view Fig. 9, the form for the back of the deck slab was sheathing on beams spanning between buttresses. A very rigid panel was required to form the face of the deck slab as the span was 18 ft. and there could be no tie rods through the slab between buttresses. Ease of handling had also to be considered. A panel 2 ft. wide and 18 ft. long (Fig. 8) was designed by the authors. The rigid construction of the panel will be noted. After being set side by side up the deck as shown in Fig. 10, the ends of the panels were fastened down by the T-rails as shown by Fig. 8. Then they were clamped between ends by waling timbers held by truss rods as shown by Fig. 8.

Four bays of the deck between expansion joints were concreted at once in lifts several form panels high. This is clearly shown by Fig. 10. A 1:2:4 concrete was chuted directly into the forms by the chute arrangement, shown by Fig. 11. The method as described proved very successful. The panel forms were reasonable in cost, could be easily shifted and could be removed repeatedly without damage and used over again.

Construction Organization—The organization with E. M. Urban as superintendent in complete charge of all work consisted, besides workmen, of: 1 general carpenter foreman, 5 sub-foremen, 1 rigger foreman, 3 sub-foremen, 1 concrete foreman, 1 sub-foreman, 1

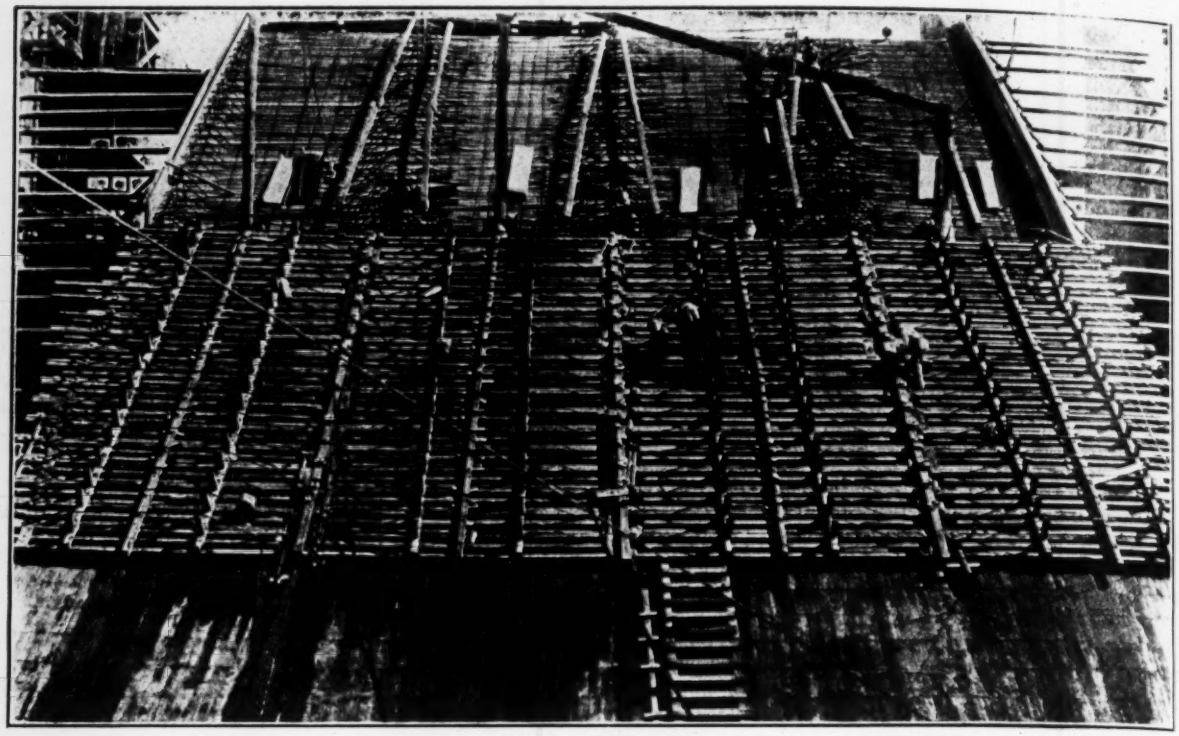


FIG. 10—CONCRETING DECK SLAB UNIT BETWEEN EXPANSION JOINTS
Using 2x18-ft. panels the sloping deck was concreted from bottom to top, in sections 72 ft. wide between expansion joints, by direct spouting into the forms.

crusher foreman, 1 steel foreman. 1 sub-foreman, 1 clamshell derrick engineer, 1 master mechanic and 5 labor foremen, directing various kinds of work. There were approximately 450 men employed, consisting of carpenters, riggers, iron workers, cement finishers, common laborers, hoisting engineers and mechanics for maintenance of equipment and machinery.

The working hours were from 7 a.m. to 6 p.m., making a ten-hour day. The living quarters consisted of a large headquarters building, with large airy offices on the second floor, and sleeping and living rooms on the first floor Comfortable cottages, fully equipped with water, electric light, etc., were furnished to families of foremen. A large mess hall and bunk house accommodated about 200 men. There was also a mess hall for Negro and Mexican labor, equipped with shower baths and lights. In fact everything possible was done to afford comfort and good and clean wholesome food for all employed on the job.

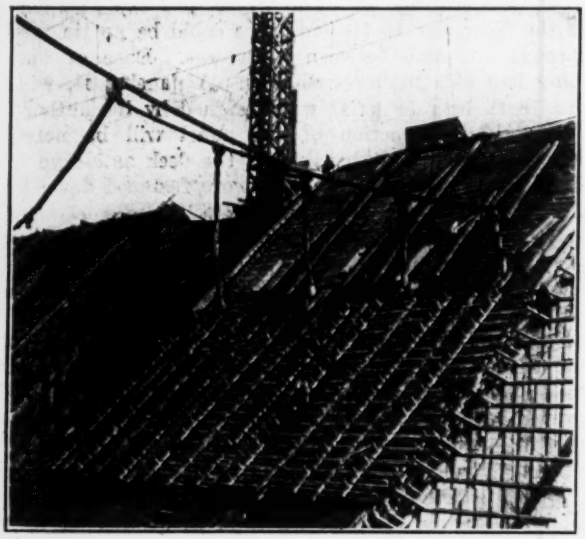


FIG. 11—CHUTE ARRANGEMENT FOR CONCRETING DECK SLAB

A North Sea Car Ferry

The successful operation of car ferry steamers across the channel between England and France during the war has led to establishing a car ferry across the North Sea from Harwich, England, to Zeebrugge, Belgium, to be operated in connection with the London & North-eastern Ry. and the Belgian State Railways. The advantages claimed are in economical and rapid transport, owing to the elimination of handling at the ports; also the saving of time, reduced cost of handling, small risk of breakage and pilferage, and saving in the cost of packing. A large business is expected in perishable goods, rolling-stock, locomotives and heavy machinery which otherwise could only be transported when dismantled and packed. Special facilities are granted by the customs authorities. The Great Eastern Train Ferries Co., of London, has purchased three steamers, each having capacity for fifty-six 10-ton freight cars on four tracks. One of the transfer bridges for connecting the dock with the steamer was lost at sea while being towed from Southampton to Harwich. It was supported on two barges, one of which sank owing to rough weather, and in going down it pulled the other barge over. It was expected that the bridge could be raised.

Concrete Road Built of Precast Slabs As Experiment

Slabs of Three Sizes Were Used in One Mile of 18-Ft. Pavement Laid on Adobe Marsh Land Near Suisun, Calif.

AN EXPERIMENTAL road of precast reinforced-concrete slabs has been constructed by the California Highway Commission at Suisun about midway between San Francisco and Sacramento. The purpose is to study methods of construction and costs as well as behavior in service, using three sizes of slabs and building some of the road of concrete in place for purposes of comparison.

The pavement was made 18 ft. wide and 6 in. thick throughout the job. Approximately one mile was constructed of precast slabs and about one-half mile was cast in place using concrete mixed at a central mixing plant and hauled to the site in trucks. Most of the slabs laid are 9x9 ft. in size, but two short stretches are of slabs 6x9 and 3x9 ft., respectively. All slabs were handled by means of lifting chains and hooks engaging cross rods of reinforcing steel in small holes cast in the slab. The 9x9-ft. and 6x9-ft. slabs have four holes each, a pair being located near each end at approximately the quarter point on the transverse dimension. The 3x9-ft. slabs were provided with two holes each.

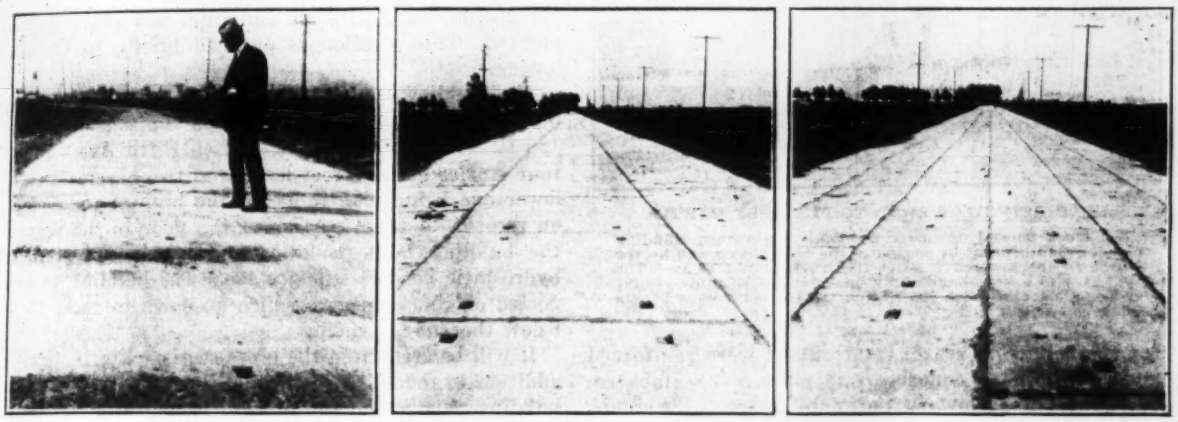
The casting yard comprised four acres bordering on a spur track in the outskirts of the city of Suisun. The yard was laid out so that slabs could be cast flat in parallel rows, the rows being separated 2 to 5 ft. to afford space for runways. Side forms were placed and the subgrade in the casting yard was prepared as when pavement is to be cast in place on the road. Cross forms, however, were placed in order to make the slabs of the desired dimensions. In each row alternate slabs were cast and allowed to set for 24 hours after which the cross forms were removed, and after oiling the exposed concrete edges the remaining slabs were cast. After casting the ground layer, additional tiers were cast on top of one another to a total height of three tiers, single-ply roofing paper being used between tiers to prevent bond. The mix used was 1:2:4, and the slabs weighed approximately 1, 2, and 3 tons, respectively for the 3x9-ft., 6x9-ft. and 9x9-ft. sizes. Work of casting the three different sizes was carried on simultaneously.

Various types of reinforcing were used; some slabs have both mesh and rods, some contain rods alone and in others no steel other than the rods at the lifting eyes was used. The slabs were not moved until the concrete had been fully cured. The slabs were cast first, and while they were curing concrete from the mixing plant in the casting yard was hauled the two miles to the road and the cast-in-place pavement was completed. Of this half-mile, approximately one-third was constructed without expansion joints, one-third with elastite joints at intervals of 30 and 40 ft. alternately, and one-third was built with elastite joints similar to those last noted but with the addition of loose dowels passing through the elastite to prevent the pavement on one side of the joint from rising above the abutting section.

By the time the half-mile of pavement cast in place had been finished the precast slabs were cured and the operation of placing them was begun. The slabs at the end of the work nearer the casting yard were placed first, thereby permitting the use of the finished pavement over which to haul the slabs and avoiding any disturbance of the prepared subgrade.

Side forms were used in preparing the subgrade for the present slab section of the road as if the pavement were to be cast in place. The soil was first removed to a depth of 1 or 2 in. below subgrade and 1 or 2 in. of clean dry sand was placed and struck off to a true grade just in advance of the placing of the slabs. The pavement was laid on an old road bed which is a thin crust over marsh mud. The road traverses marsh lands at this point and the pavement itself is but slightly above the extreme high tides, hence the water table is very close to the subgrade.

The slabs were loaded, by means of a crane at the casting yard, onto the bed of the delivery truck. On arrival at the work the truck backed under a gantry crane spanning the pavement just over the last slabs placed. This crane picked up the slabs from the truck bed and delivered them to place on the subgrade. Three men were employed at the yard loading slabs and three men and a foreman in the road placing them. In addition one man was employed spreading the sand cushion and one man part time in setting forms. The maximum number of 9x9-ft. slabs laid in



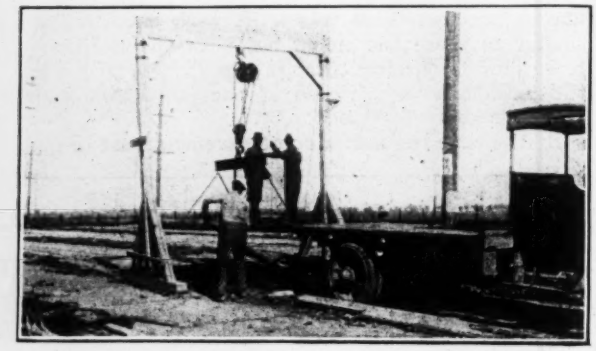
THREE SIZES OF PRECAST CONCRETE SLABS ON SUISUN PAVING JOB IN CALIFORNIA

Two rows of the largest size slabs 9 ft. square, were used to make the 18-ft. roadway. The 6x9-ft. slabs were placed with the 6-ft. dimension across the road, thus requiring three rows, and the 3x6-ft. slabs longitudinally in six rows.

a single day was 39, but due to lost time by rainy weather, wet subgrade, etc., the average day's run was only 23. The maximum run for the 6x9-ft. slabs was 37 and the average was 31 and the maximum for 3x9-ft. slabs was 60 and the average 48.

In the matter of placing, the 6x9-ft. slabs cost approximately 10 per cent more per linear foot of road than did the 9x9-ft. slabs. Had the work been more extensive, equipment better suited to the job might have been supplied, state highway officials stated, and the slab laying would have proceeded faster.

The slabs cost more than the cast-in-place concrete



SLAB BEING LOWERED TO PLACE BY GANTRY

The truck backed up under the gantry, workmen standing on the slab lifted it by means of the chain block and by the same means lowered it after the truck moved away. The 6x9-ft. slabs were handled by one man. The gantry crane was pulled ahead by one of the trucks using lines passed through blocks.

for the following reasons: (1) Slabs were reinforced and cast-in-place concrete was plain. (2) Slabs required extra formwork per cubic yard. (3) Slabs required practically two subgrades, one in the casting yard and the other at the road. (4) Slabs required a sand cushion, and were provided with elastite joints. These items, together with the hauling and placing of the slabs, made the cost of the slab pavement about $10 per cubic yard more than for cast-in-place pavement.

Slabs were cast three deep in the yard. The upper two tiers were found to have thicknesses of sufficient uniformity so that simply lowering the slabs onto the sand cushion gave a smooth, continuous surface. The lower tier, which was cast on the ground, varied somewhat in thickness. After they had been lowered to place on the sand cushion it was occasionally necessary to raise them again and rework the sand.

Heavy loads have not been frequent over this road heretofore, but extensions now planned for the canneries at Suisun will probably cause it to be subjected to heavy loads of produce in the future.

Bank Foundation Designed to Resist Flood Uplift

Sub-basement of Mellon Bank, Pittsburgh, Built as Floating Box—Heavy Floor Transmits Upward Water Pressure to Columns

BY JOHN W. PICKWORTH
Weiskopf & Pickworth, Consulting Engineers, New York City

PERIODICAL floods of the Monongahela and the Allegheny rivers at Pittsburgh led to certain difficulties in the design of foundations for buildings in the low-lying business district of the city. Much of the soil being a heavy gravel, the flood waters quickly spread to a considerable distance beyond the actual river banks, and where deep and dry basements are desired it is necessary to make adequate provision against the hydrostatic pressure in floods. This condition gave rise to a number of interesting problems in the design of the Mellon National Bank Building, now nearing completion. This solution is outlined briefly in the following.

The building, which is to be used solely for banking purposes, is about 232 ft. long on Smithfield St. and 120 ft. wide on Oliver Ave. and on Fifth Ave. It has four stories above street level, and two basements, the lower one being 9.61 ft. below the highest water level on record. A large portion of the floor in the rear of the building is 2 ft. lower and in various pits the hydrostatic head is still greater. The building is supported on concrete piers which go down to rock, 15 ft. below the sub-basement.

It will be seen from the cross-section, Fig. 1, that in addition to the side pressure on its basement walls the building must resist the upward pressure of the water on its base, amounting to over 700 lb. per square foot for the main part of the sub-basement. This appears a formidable condition when it is realized that except around the walls, which are far apart, the upward forces are greater than the normal dead-loads.

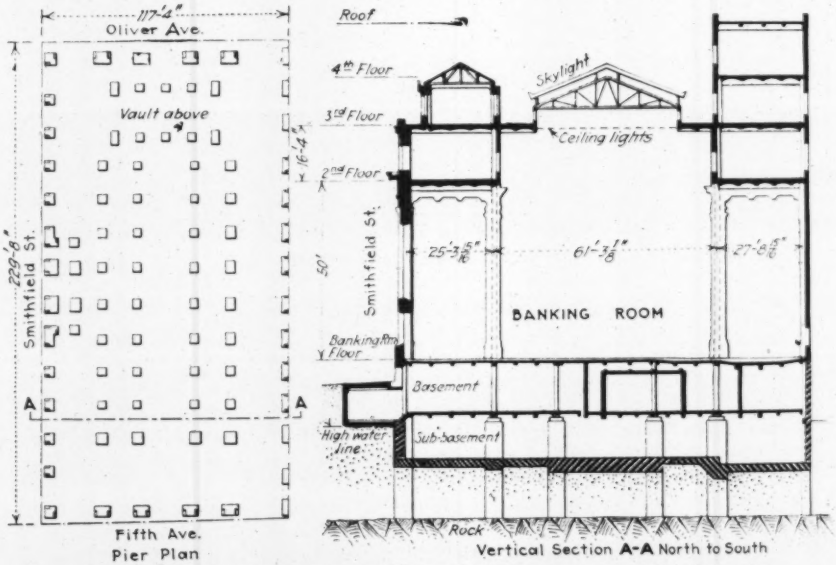


FIG. 1—NORTH-SOUTH SECTION AND PIER PLAN OF MELLON BANK

The floating-box construction of the sub-basement required on account of floods was complicated by the wide spacing of the columns. The banking room occupies the entire ground floor.

Foundations and Floor Anchorage — The security vault at the Oliver Ave. end of the bank rests on independent piers. The vault was constructed first, and enough of the permanent structure was built to house the vault and permit its use. Four wall piers and four interior piers of the main building were put in at the time the vault foundations were constructed, and, as it was then planned to carry all interior columns down to the sub-basement level, these four were constructed accordingly, as shown in Fig. 2. Hooked projecting rods were embedded in the piers, to engage the sub-basement floor and transmit the upward reaction from the floor slab to the piers.

Later it was decided to put in the rest of the foundations before tearing down the occupied buildings on the site. As the basements for these old structures

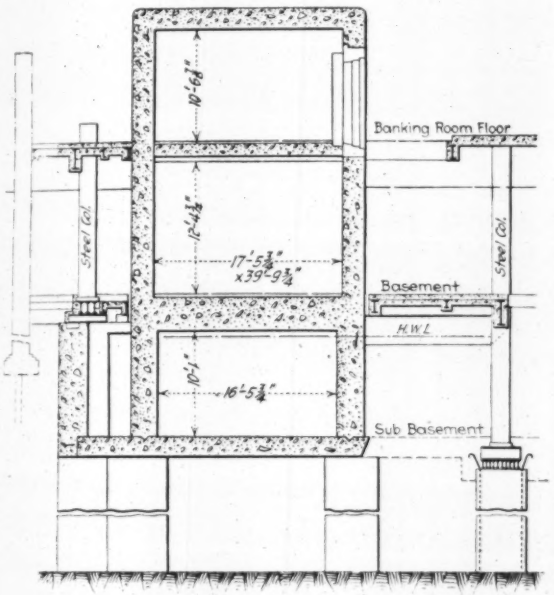


FIG. 2—INDEPENDENT VAULT IN EAST END OF BANK

At right is shown one of four building piers built at the time the vault was constructed, while the old building was still in use. The pier extends up to sub-basement floor level only. Hooked bars were built into the pier to anchor the floor slab, built later. All other interior piers of the building were carried up to the next floor above, giving more weight for resisting hydrostatic uplift; the sub-basement floor, built later, engages notches molded in these piers.

were not as deep as those planned for the new bank, the column grillages were designed to go in at basement level, and the sides of the piers were notched to receive the sub-basement floor, as shown in Fig. 3. Vertical reinforcing brings into action the full weight of the pier, as well as the column load above, as a reaction against the water pressure.

Sub-basement Floor—The sub-basement floor, of reinforced concrete, is designed to carry the upward forces in the most direct manner to the various points of load concentration from above. There is little dead weight in the central portion of the building, by virtue of the architectural layout of the banking room, which has but two main lines of interior columns, 62½ ft. apart. The banking room floor and the first basement floor were made of 6-in. stone-concrete slabs supported by steel framing, to add to the dead weight; concrete thus added is more effective than that used to thicken

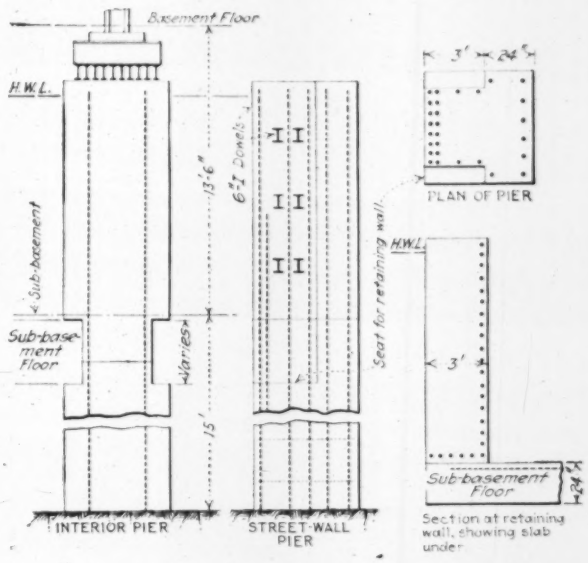


FIG. 3—CONNECTION OF SUB-BASEMENT FLOOR TO PIERS AND RETAINING WALL

the sub-basement floor, because in the case of the latter every foot added increases the hydrostatic head by the same amount, and the only gain is the difference between the weight of the concrete and the weight of the water. Nevertheless it was necessary to make the central part of the sub-basement floor 4 ft. thick.

This part of the floor is designed with a cantilever extension of 3 ft., as indicated in Fig. 1, and the floor of the side bays is cantilevered out beyond the main interior columns to meet this first mentioned portion. The slab extends under the retaining wall, or else reacts against the notches left in the face of the wall piers. Concrete girders cast monolithic with the slab carry the upward reactions to the notches in the interior piers. At either end of the building the slab has a clear span of about 36 ft. and is 3 ft. thick.

Special slab, beam and girder construction is designed to take care of the elevator pits and the sump pit, which goes down to a depth of 7 ft. below the low

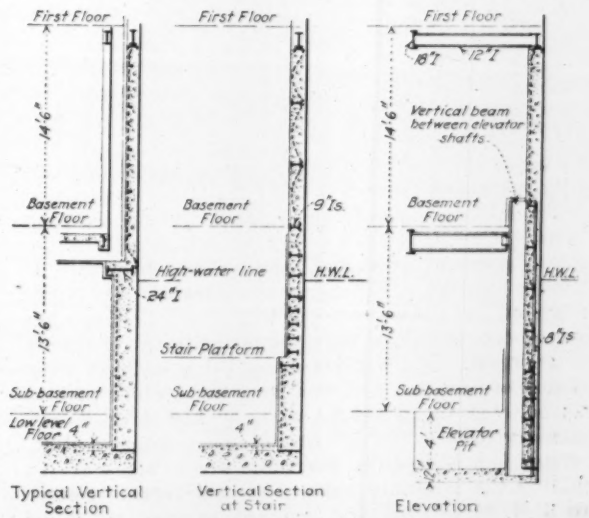


FIG. 4—THIN RETAINING WALL AT REAR OF BANK

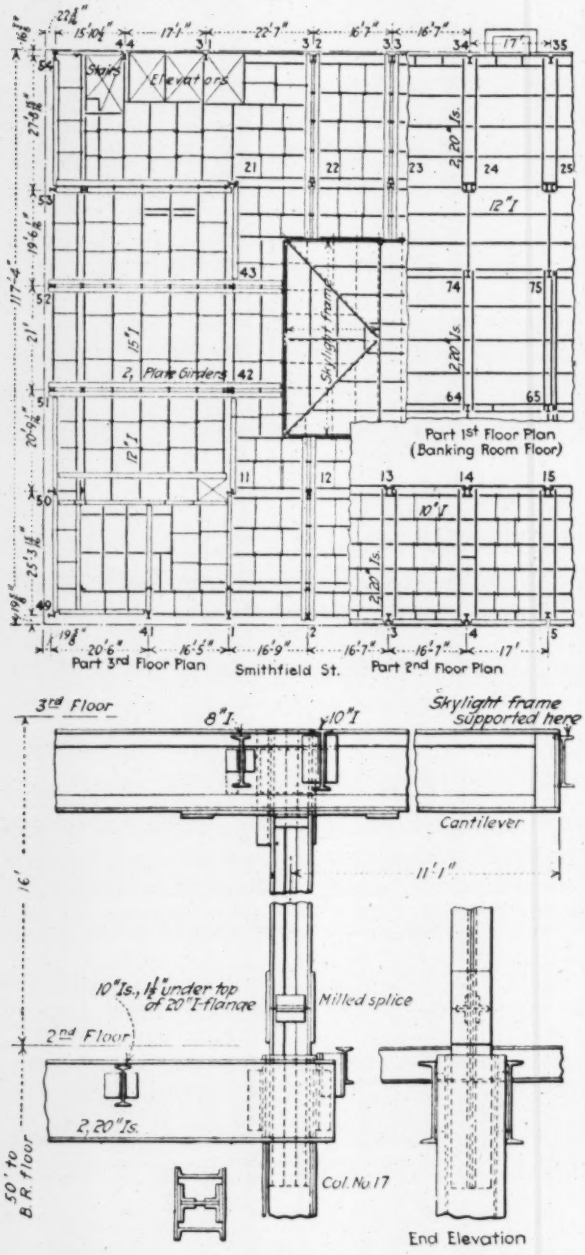


FIG. 5—STEEL FRAMING AND SOME DETAILS
Banking-room column splice at third floor, and skylight supported on cantilever girders.

portion of the floor. The hydrostatic head calculated at the bottom of this pit is 19.61 ft., which means that the upward pressure exceeds 1,200 lb. per square foot.

The entire design of this floor lent itself to the establishment of good and proper lines on which to stop the pouring. The concrete contractor was asked to lay out the lines and areas that would best suit his convenience, and these were submitted to the engineers for approval. The various areas being entirely independent of each other, it was immaterial which portion was selected to be poured first, or how long it was necessary to delay the pouring of the adjacent section.

Retaining Walls—On the three street sides of the building the retaining walls in the sub-basement story are 3 ft. thick, and are designed to span as beams between the piers that carry the wall columns; 10-in. seats are left in the piers for this purpose. The upward reaction of the sub-basement floor is in most instances more than balanced by the wall load, but where because of the sidewalk vault the weight is insufficient the retaining wall was doweled into the piers with 18-in. lengths of 6-in. I-beams, which make good dowels for shear and to which it is easy to fit the forms.

Along the rear lot line the retaining wall had to be kept much thinner. The typical section for the two basement stories is shown in Fig. 4. The wall is a vertical reinforced-concrete slab which throws its reaction against the sub-basement and banking-room floor levels. The 24-in. I-beam laid flat is so placed to allow passage for the ducts above, and it frames into the steel column shaft just above the level of the grillage. The accumulated horizontal pressure is then transmitted through the column and the girder connection to the whole of the floor system. Back of the stair and elevator shafts the wall had to be kept exceptionally thin; here structural steel framing was used.

Pier Design—Special care had to be taken in the design and detail of the concrete piers. On the three street sides the piers have to carry, in addition to their vertical loads, the horizontal reactions of the retaining walls and the forces on the outside faces of the piers themselves. To do this they are designed as cantilevers, using the heavy, sub-basement floor as a fulcrum point. Fig. 3 shows typical conditions.

Waterproofing—All the concrete for the sub-basement floor and the walls up to the curb level contains integral waterproofing compound. In addition to this, an inside coating of Cow Bay waterproof cement mortar is carefully applied under special specifications. This hydrolithic coating is ⅝ in. thick on the walls and 1 in. thick on the floors.

Superstructure—The most interesting engineering features of the building superstructure (Fig. 5) are banking-room columns, which have an unbraced height of 50 ft., and the third floor framing, which cantilevers out to support the roof and skylight over the central portion. The high columns are of box section, made up of two 12-in. channels and 18-in. cover plates. To avoid having this large section run through the second floor to the splice line, which would necessitate extra furring and occupy valuable floor space, a special detail was made for this point, as shown in Fig. 5.

The 40x130-ft. skylight is supported on the ends of the 11-ft. cantilevers of the third floor; it has a heavy protective screen over it.

In construction, no difficulty was experienced from water. Had a high flood occurred before there was sufficient weight on the foundations to withstand the pressure, it would of course have been necessary to admit the water freely and let it flood the sub-basement.

Trowbridge & Livingston and E. P. Mellon are the associated architects for the bank. The vault and the first section of the building and the piers were constructed by the Hughes-Foulkrod Co., with the McClintic-Marshall Co. as subcontractors for the structural steel. The main building is being put up by the Mellon-Stuart Co. The Carlem Engineering Co. is the subcontractor for the reinforced-concrete work, and the American Bridge Co. for the structural steel. The design was made and the engineering services were rendered by the firm of Weiskopf & Pickworth.

Federal Land Reclamation: A National Problem

2. The Development of the West Under Irrigation

By C. E. GRUNSKY
C. E. Grunsky Co., Engineers, San Francisco, Calif.

The Second of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West.

PROGRESS in the West under irrigation has been truly remarkable. Let us take a few concrete examples beginning with one of the most recent developments, the Imperial Valley. Perhaps the reader may not recall that the region now covered by the Imperial Irrigation District was known to the pioneer as the New River country, taking its name from one of the channels in which flood waters of the Colorado River occasionally flowed north into the Salton Basin. These waters came from the delta region of the river where, in Lower California, they submerged and wetted thousands of acres, where the rank vegetation showed that the desert of the Southwest could be converted into arable land if water could be brought to it. The scheme of Dr. Wozencraft and his associates in 1859 to have the U. S. Government give California 3,000,000 acres of lands in the southeastern part of the state for reclamation having been blocked—and perhaps wisely, because it would have been a premature enterprise—the desert areas of the Salton Basin, included in the region designated on the old maps as the Colorado desert, remained for many years a barren waste, treeless, without grass and repellent to every form of life. The project to irrigate this almost rainless area was revised in the last years of the last century and irrigation water became available there in 1902. Without dwelling upon the difficulties that had to be overcome, let it suffice to say that there are now about 450,000 acres of land under cultivation in Imperial Irrigation District, every acre of which requires water from the irrigation ditch; and, south of California in Mexico from the same canal system which brings Colorado River water into California, an additional area of about 200,000 acres is now being irrigated. The property value created in California by this one enterprise exceeds $100,000,000. The annual crop output has a marketable value, not including the products of lands in Mexico, of more than $50,000,000. The population of Imperial Valley has reached 60,000—an asset to our country that is certainly worth while.

San Joaquin Valley—Going further back contrast for a moment the situation in the San Joaquin Valley, also in California, as it was 60 years ago and as it is today. Here and there under natural conditions with rain generally 5 to 10 in. in a year there was grass for sheep and stock. In favored localities the early settler would even attempt to grow grain. The occasional year with moisture sufficient to produce a crop would prompt other attempts, but dry farming was not successful except to a moderate extent along the base of the Sierra Nevada at the eastern margin of the valley and northward from the Stanislaus River where there was a more dependable rainfall. The waters of Kern, Tule, Kaweah, Kings, San Joaquin, Tuolumne and Stanislaus rivers were at that time flowing unused to the sea. The population consisted of a few blacksmiths, the crossroads saloonkeeper, here and there the staff of a country hotel and the sparse population of the frontier region centering in the widely scattered cattle ranches with pre-emptors and homesteaders in favored spots seeking some gullible speculator who would take their holdings off their hands. And now one finds prosperous communities from end to end of the valley made possible by irrigation. Of course, the irrigation commenced in a haphazard way with small ditches here and there, at points where diversions could be made from the stream with inexpensive works. But results were encouraging; the small individual ditch was soon replaced by larger ditches serving a number of irrigators. Commercial enterprises such as the great San Joaquin and Kings River Canal were started, though often, as in the case of this canal, they proved financial failures while in the hands of the original projectors. Later came co-operative enterprises with consolidation of irrigation systems with better, more dependable service, and finally the irrigation district, based on the sound doctrine of community enterprise, and ownership of the water rights by the land on which the water is used. To be a little more specific, Bakersfield, Tulare, Porterville, Visalia, Hanford, Corcoran, Lindsay, Dinuba, Reedley, Sanger, Fresno, Madera, Merced, Los Banos, Tracy, Manteca, Oakdale and many other communities owe their development and growth to the use of water by the irrigator. This growth can perhaps best be illustrated in figures.

There were invested in the irrigation enterprises of the San Joaquin Valley southward from Stockton in 1920, according to the U. S. Census, about $69,000,000. The land under cultivation by irrigation in this part of the valley in the same year had an aggregate area of over 2,000,000 acres. The population of this region already exceeds 250,000.

Southern California—Still greater is the progress made under and due to irrigation, in that part of California generally referred to as Southern California. The need of irrigation in this semi-arid region was early recognized. The development thereof as noted in the citrus industry, the growth of San Bernardino, Riverside, Redlands, Pasadena, Los Angeles and San Diego, which may be cited as typical, would not have been possible without the utilization for irrigation of the water resources of the southern section of the state. In the central and northern portion of California the value of irrigation was not so early recognized because nature furnishes to these more northerly areas a more bounteous rainfall. But now the advantage of applying water to the land by artificial means to supply deficiencies and to prolong the growing season is apparent to all, and the demand for irrigation water is constantly on the increase. The natural flow of even so mighty a stream as the Sacramento River no longer suffices. Regulation of flow by storage is becoming imperative.

As in California, so elsewhere in the West, in Washington, in Eastern and Southern portions of Oregon, in Idaho and Montana, in Wyoming and Colorado, in Utah

and Nevada, in Arizona and New Mexico, in all of these states the development under irrigation has been little short of marvelous—to say nothing of the growing of rice in the Gulf States.

Government Aid in Irrigation

The early irrigation works were of the simplest type, easily constructed at trifling expense. When the water had to be taken to points remote from its source, to lands less favorably located than those covered by the first canals, co-operation became essential. Mutual water companies were organized and many commercial or speculative ventures were undertaken. Presently it was found that the natural low water flow of the streams would not longer suffice to meet the demand of the growing irrigated area. Recourse must be had to storage in order to regulate the stream flow and to conserve the waste at the flood stages. Government aid was enlisted. The states began a study of their water resources. The formation of irrigation districts was authorized. The Congress of the United States, too, saw the need of encouraging the reclamation of desert areas and made provision for the same in the under consideration about 40 per cent while in the Mountain and Pacific states, as shown in the table, the population more than doubled.

The figures in the second table, also taken from Census statistics, will show that irrigation is widely practiced and has contributed in large measure to the marvelous prosperity of the country already shown by the figures in the first table.

Financial Benefit of Irrigation—In the 19 most westerly states including Arkansas and Louisiana there had been invested in irrigation enterprises over $321,000,000 in 1910 and over $697,000,000 in 1920. In these states, considered together, about 9 per cent of the improved farm area was irrigated. In Arizona about 65 per cent of the improved land is irrigated. For California this percentage is approximately 35, for Colorado 33, Idaho 55, Montana 15, Nebraska 2, Nevada 95, New Mexico 31, Oregon 20, Utah 80, Washington 7, and Wyoming 58.

The value of the principal crops produced in 1919 on the irrigated lands of the eleven Western states is given in the United States Census as $702,441,166. Through the farmer this sum finds its way to the

TABLE I—DEVELOPMENT OF THE FARMING INDUSTRY, 1860-1920: MOUNTAIN AND PACIFIC COAST STATES (IRRIGATION STATES) COMPARED WITH UNITED STATES AS A WHOLE

	1860	1900	1910	1920
United States				
Population	31,443,321	75,994,575	91,972,266	105,710,620
Number of farms	2,044,077	5,737,372	6,361,502	6,448,343
Area of farms, acres	407,212,538	838,591,774	878,798,325	955,883,715
Improved land, acres	163,110,720	414,498,487	478,451,750	503,073,007
Value of farms, (land and buildings)	$6,645,045,007	$16,614,647,491	$34,801,125,697	$66,316,002,602
Value of all crops*	.....	$3,496,700,000	$5,231,850,000	$14,755,365,000
Mountain and Pacific Coast States				
Population	618,976	4,091,349	6,825,821	8,802,872
Number of farms	34,664	242,908	373,337	478,273
Acreage of farms	12,717,667	93,796,860	110,862,209	123,489,941
Acreage of improved land	3,686,942	27,155,681	37,953,010	54,027,401
Value of farms (lands and buildings)	$70,488,320	$1,294,479,856	$3,797,543,127	$7,832,604,517
Value of all crops*	.....	$197,435,000	$445,975,000	$1,611,000,000

* These figures are given for the year preceding the census year. They do not include live-stock products.

Carey Act. As a final means of stimulating home-building on the irrigated farm, government aid has been extended throughout the West under the provisions of the United States Reclamation Act passed in 1902. Over $135,000,000 has been expended by the U. S. Reclamation Service in the construction of works many of which could not have been undertaken without government aid. All of this has been a powerful factor toward the development of a part of the world ideally adapted to support in comfort a dense population.

Stimulating Effect of Irrigation—The examples above cited are crudely illustrative. Perhaps a few figures relating to the growth of the West under the stimulating influence of irrigation will give a better picture of past achievements and of the progress still being made (Table I). The states included as irrigation states in the summary presented in this table are: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon and California.

From such statistics as presented in this table, compiled from the U. S. Census, it appears that while the value of the farms in the entire United States was four times greater in 1920 than in 1900 the value of the farms in the Mountain and Pacific states was six times greater in 1920 than in 1900. The value of the farm products in the entire country was four times greater in 1920 than in 1900 while in the Mountain and Pacific Coast states under the stimulating influence of irrigation the value of the output of the farms was eight times greater in 1920 than in 1900. The population in the entire United States increased in the twenty years transportation agencies, to merchants and professional men, to educational institutions, to amusement places and some goes for taxes. It is fair to assume that what the second man gets goes to a third within a month, and so on, making the volume of business that results in a year from the activity of the irrigators in these states appear at many times this amount. Here, then, is a clear indication of the influence of irrigation upon the development of the West.

Future Extension of Irrigation

On the subject of the amount of water that remains available in the streams for new enterprises and the extension of irrigation systems already in service it is interesting to note what is said on this subject in the U. S. Census of 1920: "Taking the western part of the United States as a whole, with few exceptions, the low water flow of the streams is exhausted, but there is a very large supply of flood water available for storage. There is no lack of tillable land on which this water can be used. Future extension of irrigation depends on whether economic conditions are such that the value of the crops which can be produced will justify the expense of storing the flood waters."

It must not be forgotten, furthermore, that the permanency of the irrigator's business depends upon his being able to get more for his crop output than it costs him. Not, of course, all the time but dependably, based on average conditions. There is, therefore, a cost limit, varying according to many factors such as character of crop, access to market, the hazards of produc-

tion and other elements beyond which he cannot go in providing irrigation works. It is not to be wondered at that he welcomed government aid in the extension of irrigation to projects that presented somewhat greater difficulties than had to be overcome by the early settlers who selected favored locations. Nor is it surprising that there are many who even with government aid have not been able to keep their farm and family expenses within the limit of crop returns and who in consequence would rather have the United States give them a still greater bonus, than admit defeat and surrender their holdings to some one better equipped to produce results. The bonus which it is intended should go to the irrigator under the U. S. Reclamation Act is given indirectly. It is the difference between what the irrigation works would cost if undertaken by the farmer as a private or community enterprise compared with a charge to him by the United States at cost without interest on the deferred payments. Estimated at 5 per cent interest, the irrigator is expected to pay only about 55 per cent as much under the Reclamation Act for his irrigation system as he would pay for the same if it were constructed without government aid. If interest during the construction period and interest on the investment during the development were taken into account the bonus would appear still higher than these figures show. It should be remembered in this connection that the intended bonus did not always go to the present owner of the land. Whatever increment of value was added by the construction of the government irrigation system would naturally be retained by the preceding owners, where there had been any, and this value was no doubt in many cases overestimated. The present owner, in such circumstances, may have an extra burden to carry which, however, he has voluntarily though sometimes unwisely assumed.

TABLE II—NUMBER AND CAPACITY OF IRRIGATION WORKS

Drainage Basins	Main Ditches Number	Main Ditches Capacity Sec.-Ft.	Reservoirs Number	Reservoirs Capacity Acre-Ft.	Pumping Pumps Number	Pumping Capacity Sec.-Ft.
Missouri River and tributaries	12,784	167,891	1,220	4,860,616	689	1,790
Mississippi River and tributaries (not including Missouri River)	2,957	41,974	381	1,163,306	1,715	4,980
Gulf streams, other than Mississippi and Rio Grande	1,632	20,931	360	305,415	3,208	20,500
Rio Grande and tributaries	2,890	40,424	351	3,233,164	709	6,050
Colorado River and tributaries	7,098	66,249	798	1,675,988	881	2,380
Great Basin Drainage	5,545	57,717	935	2,395,379	1,270	2,760
Columbia River and tributaries	12,614	134,536	646	5,711,783	1,745	5,610
Pacific Ocean streams other than Colorado and Columbia Rivers	5,926	100,804	2,771	1,815,714	23,378	36,500

Overproduction and the Time Element—Periods of overproduction of farm products such as that through which we are now passing with resulting low prices, are discouraging to the farmer and we find in consequence that the question is asked with increasing frequency, Why extend irrigation still further? Why add still further to the surplus of farm products which cannot be disposed of? The answer is simple, though of course not entirely satisfactory, that the periods of overproduction, regardless of causes to which they may be due, are recurrent and that the farmer will again come into his own within a few years. It must not be forgotten that time is an important factor to take into account when the merits of any project for the further extension of arable and particularly of irrigable lands is under consideration. For the full development of a large irrigation project 10 to 30 years should be allowed. This time allowance, moreover, is reflected in the estimated cost and may become a material factor. In such large proposed projects as that of the Columbia Basin and that of the lower Colorado River where irrigated areas are talked of in millions of acres, this is particularly true. These are projects involving the regulation and control of streams which are of the interstate type. On such streams the United States should provide or should in any event control the works for the regulation of flow, and before undertaking or authorizing construction should be satisfied that the proposed projects are feasible, not alone from engineering considerations but also from the economic standpoint. Can the power and the water be disposed of at prices that will return fair interest on the investment? This is the test and this test cannot be fairly applied without a proper consideration of the time element.

Cost of Water Rights—And now a word as to what the irrigator can afford to pay for water. Some 30 or 40 years ago so-called water rights could be bought in various parts of California. These water rights entitled the holder to some fractional part of the water in a main or branch canal and were paid for at a fixed price per acre or per unit of the canal flow. In the San Joaquin Valley, California, the price of $10 per acre soon became almost standard, it later went to $20. It could be considered either as a bonus paid by the irrigator to the canal owner or as an advance payment of rates. The water right contract usually runs with the life of the canal company and is therefore limited in duration and usually carries with it an obligation to make annual operation and upkeep payments in definite amounts per acre. The price fixed by the canal company for the water right was generally intended to reimburse the company for its capital outlay, but sometimes, due to limited demands for water rights, this was very slow in coming in. In southern portions of California, where the need for water was greatest and benefits largest, the crop output being valuable, and where the natural flow of the stream in proportion to the available land was unusually small, the water rights were soon at $1,000 to $2,000 per miner's inch, or $50,000 to $100,000 per second-foot, representing an investment for water of $150 to $300 per acre.

The early practice of canal owners was to confine construction of the irrigation system to the main canal and principal branches, letting the farmers build as they might such laterals and distributing ditches as they needed. This fact is to be taken into account in comparing costs of systems as constructed early in the history of irrigation with recent costs for systems, complete, with delivery of water to each small holding.

It is not possible to give with any degree of precision the amount per acre which the land owner can afford to pay for irrigation water. Much depends in this connection on the location of the land, its adaptability to produce crops under irrigation, upon transportation facilities and similar factors and also upon the value of the land before irrigation water is made available. If arid land is in question which is almost without value until irrigated, the increment of value added by the irrigation canal may be relatively large. In the case of land already in use with sufficient rainfall to warrant the planting of grain crops the amount which the owner

can afford to pay for irrigation water may be considerably less than when arid land is to be irrigated. As a general proposition the irrigator of diversified crops can afford an annual outlay including interest on the investment of $5 to $10 per acre for irrigation water, the larger amount only, however, if the irrigated lands include a large proportion of vineyard, orchard or truck gardens. Where there is but little truck gardening and the area in orchards and vineyards is small an expenditure for a gravity system of irrigation works in excess of $80 per acre will be justified only in exceptional cases.

When irrigation is accomplished by pumping, interest on the first cost of the installation may be but a small fraction of the cost of the water. The main element of expense, depending upon the head against which the water is pumped, will be the power and attendance required at the pumping plant. Favorable conditions as to crops that can be grown and favorable market conditions may, of course, warrant a large annual outlay for the operation of such a pumping plant, but here again special studies should be made of each particular situation whenever the estimated cost of the service per acre including interest on the investment goes over $5 or $6.

Precast Concrete Cribbing for Retaining Walls

Units Placed Easily and Quickly—Drainage and Foundations Simplified—Extensive Use in Railway Work

CELLULAR retaining walls of precast concrete units, as an economical development of the common practice of using old ties and timber for temporary cribbing to restrain the slopes of fills, are being employed in a number of cases, since increasing cost of construction work has emphasized the economy of such permanent crib walls as compared with timber cribbing or even with solid retaining walls. Different types of concrete units have been developed and numerous structures installed under severe conditions have demonstrated both economy and satisfactory service. Concrete crib walls of the "Interlock" type, shown in Figs. 1 and 2, with details in Figs. 3 and 4, are being used by several railroads and industries.

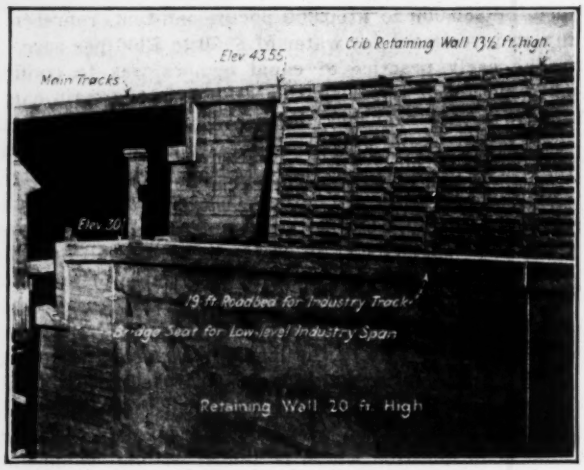

Crib Retaining Wall 13½ Ft. high.
Elev 43.55
Main Tracks
Elev 30'
19 Ft. Roadbed for Industry Track
Bridge Seat for Low-level Industry Span
Retaining Wall 20 Ft. High

FIG. 1—CRIB RETAINING WALL ON ROCK ISLAND LINES; CHICAGO

Poured retaining wall 20 ft. high. Crib wall 13½ ft. high, set back 19 ft. from lower coping. Industry track at foot of cribbing and main tracks at top.

In this type of cribbing there are three forms of precast pieces, designated as headers, full-length stretchers and half-length stretchers (see Fig. 3). Ordinarily only the first two are used, the half-length stretcher being employed occasionally where a wing wall with plumb end is desired. Their steel reinforcement is furnished built-up ready for placing in the forms. These concrete units are installed with one or two parallel rows of longitudinal stretchers supported transversely by the headers, but for comparatively low walls only one row of stretchers is required. It will be noted that the longitudinal unit or stretcher is formed with a supporting member at the middle, thus

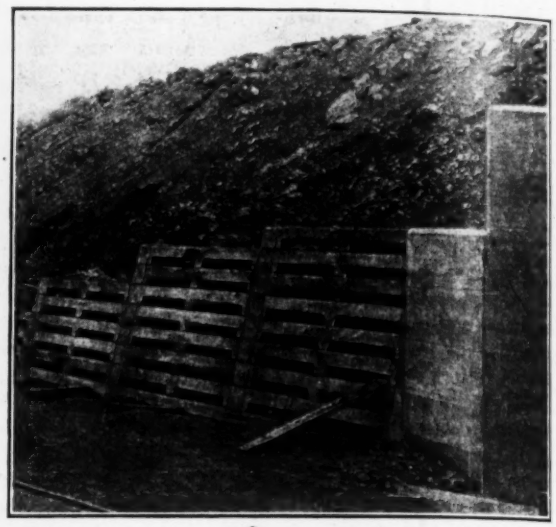


FIG. 2—CONCRETE CRIBBING RETAINS TOE OF FILL

allowing the vertical joints to be broken or staggered without the necessity of additional blocks or fillers. The ends of both stretcher units are recessed so as to interlock with the T-head headers.

The large crib wall shown in Fig. 1 forms a bench for an inclined industry track in the slope of a main track embankment about 33 ft. high, on the Chicago track elevation work of the Rock Island Lines. Here the cribbing, 10 to 13½ ft. high and with a face batter of 1 in 12, rests on a fill supported by a retaining wall approximately 20 ft. in height, which was built prior to the installation of the cribbing. Some of the half-stretchers will be noted in the end bay, between the headers and the bridge abutment. This crib wall built into the fill was adopted instead of a second retaining wall, since the latter would have involved great cost for a solid wall either on pile foundations or with masonry extending to the ground. The low-level bridge for the industry track was not in place when the view was taken. Similar construction has been employed on the Detroit track elevation of the Michigan Central R.R., but with both the upper and lower walls built of cribbing.

The Chicago installation, made under severe foundation conditions, has been in service more than seven years and it is reported that in addition to great saving in first cost the service results have justified its use. Although the embankment settled considerably during the first year after the wall was constructed, the flexibility or elasticity of the cribbing allowed the units to adjust themselves without detrimental effect to the stability of the wall. Other crib walls were built on the same project and with such success as to lead to

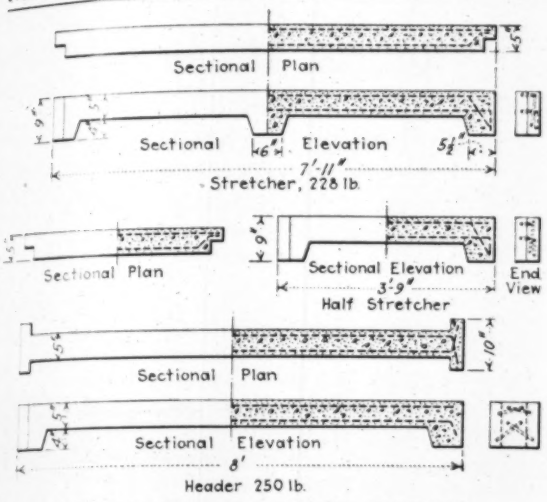


FIG. 3—UNITS FOR CONCRETE CRIBBING

the adoption of this system by engineers on other works. In general, the cribbing is used for retaining or restricting the slopes of fills, but it has been applied also along the toes of wet and sliding cuts. A crib toe wall on the Chicago track elevation work of the Illinois Central R.R., shown in Fig. 2, is at the Main St. bridge at Matteson. In this case, the headers are not staggered and no half-stretchers are employed, as in the arrangement shown in Fig. 1.

These precast units are of sufficient length to take care of the wall heights commonly required and can be handled by common labor without the use of special equipment. The high wall in Fig. 1 was built by a foreman with four laborers. The units are placed as the filling proceeds and are not built up to any considerable height in advance of the filling. By this method and by eliminating the usual period required for the placing and curing of poured concrete there is considerable saving in time. The theory and practice of design are similar to the case of solid walls, but owing to the uniformly distributed dead load and to the rectangular section causing the embankment pressures to be applied at a greater distance from the face of the wall, the toe pressure is reduced to a minimum and the latitude of uses for cribbing on relatively soft foundation soils is increased materially.

Advantages claimed for the concrete cribbing include: Low first cost of construction, speed of erection, use of unskilled labor, adaptation to congested territory, ample drainage of wet filling, freedom from frost troubles, distribution of load on soft ground, flexibility of design to allow of its use without foundation construction, small number of types of units, and salvage value in case of reconstruction or a change in height of wall. This type of structure is considered to be adapted particularly for temporary or permanent use on railway and highway work where reduction in cost and time of construction is important, or where it is desirable to avoid such interference with traffic as might be involved by poured concrete construction. It is applicable also in various other cases, as in walls at industrial plants, an example of such work being the construction of walls to retain a coal stockpile at a manufacturing plant. The concrete units may be made by contract or by railroad forces at any convenient point.

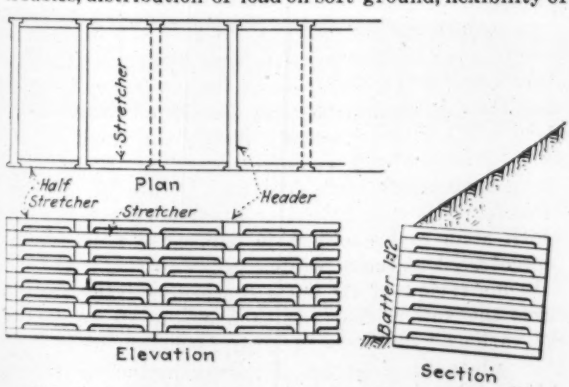


FIG. 4—CELLULAR CRIBBING OF CONCRETE UNITS

Conveyors Handle Clay at British Port

BELT conveyors for handling china-clay and loading it into steamers are a feature of a new pier at Fowey, on the south coast of England, which is an important shipping port for this material. In 1922 more than 600,000 tons of clay were shipped, largely to the United States. The pier or jetty extends at a sharp angle from the river bank, so that it has a berth 300 ft. long on one side only. Steel cylinders sunk to rock and filled with concrete support a frame of steel girders having brick arches between them and a concrete deck 50 ft. wide. Freight cars of 10 and 12 tons capacity, having the ends hinged at top, are run upon a tilting table at the shore end of the pier and dump the clay into a circular chamber 34½ ft. in inside diameter and 23 ft. deep. As this chamber, supported on foundation cylinders, extends below the water, it is made with a 33-in. concrete wall between two steel shells.

A hopper in this chamber feeds the clay upon an inclined conveyor belt traveling at 125 ft. per minute and rising to a height of 35 ft. above the pier. At the top, the clay is delivered by a transverse belt to a horizontal belt extending the full length of the pier. This belt serves a loading tower which travels along the berth side of the pier and has an inclined adjustable chute to deliver the clay into the ship's hatches. A revolving shoe or spout at the end of the chute spreads the falling clay and reduces the amount of hand trimming of the cargo in the hold. The conveyor galleries and the tower provide for duplicate equipment of belts and chutes when required. To handle clay shipped in barrels and sacks there is a 3-ton revolving crane traversing the top of a gantry traveling on the berth side of the pier and between the shipping tower and outer end of pier. Storage for twenty cars is provided on a side-track and the cars are moved to and from the pier by cables and capstans. The dumping table, conveyors, tower, crane and capstans are all electrically operated This shipping plant was designed under the direction of W. W. Grierson, chief engineer of the Great Western Ry., and was built by the Cleveland Bridge & Engineering Co.

Los Angeles Holds Out for Breakwater

Los Angeles interests already are taking steps looking to congressional sanction for their plan to construct a breakwater to provide shelter for Terminal Island. It is regarded as unlikely, however, that Congress will override the Chief of Engineers and the Board of Engineers for Rivers and Harbors, who have reported emphatically against the breakwater plan.

Formation of Transverse Fissures in Steel Rails

An Abstract of James E. Howard's Latest Report to the Interstate Commerce Commission Together with a Discussion by C. A. Morse, J. L. Campbell, C. R. Harding, and J. M. R. Fairbairn

Since the transverse fissure was first identified in 1911 as a specific type of fracture, railroad engineers and steel-rail manufacturers have been endeavoring to discover the cause and to find some means of preventing its development. James E. Howard, engineer physicist of the Bureau of Safety of the Interstate Commerce Commission, has probably done more than anyone else toward discovering the cause of this perplexing type of fracture. His latest report sets forth his views as to the cause. Knowing that many men do not hold the same views an abstract of his report was sent to a number of engineers with request for an expression of opinion. The replies from four of them, from widely scattered parts of the country, and an abstract of Mr. Howard's report are given below.

Transverse Fissures in Steel Rails and Their Prevalence on Certain Railroads

THE REPORT of Mr. Howard summarizes available data and gives illustrations of transverse fissures and a number of diagrams made from a tabulation of the rail failure reports of various railroads in this country. The new data brought out by Mr. Howard show: The location of rails which fail by transverse fissures according to mileage, on certain sections of railroads, the heat numbers of such rails and the number in each heat, the position in the track (such as the high or low rail on curves), the number of fissures displayed according to years and months, according to ingot position, and according to year rolled.

The known facts concerning transverse fissures which the report brings out are: Transverse fissures have an interior origin starting from a nucleus a few hundredths of an inch in diameter. A silvery crescent next forms, concentric with the nucleus, which increases in size until the periphery of the rail is reached. The surfaces of the fissures present a silvery luster until air is admitted. They occur in both Bessemer and open-hearth rail and in all weights of rail up to the heaviest rolled. They have been found in rails from every rail mill in the country. Fissures always occur in the head of the rail and in larger numbers on the gage side. On curves they occur more frequently on the inside rail, and on railroads having both light and heavy tonnage tracks they occur more frequently in the heavy tonnage track. In fact, on one railroad a large number have occurred in the heavy tonnage track and none have occurred in the light tonnage track. They occur in new rails and in rails thirty years old, in rails rolled in every year for which records have been kept, and in all ingot positions. Some of the earliest failures have occurred in rails coming from parts of the ingot generally conceded to be the best. Nor do bending stresses appear to cause the fissures, for incipient fissures have been found 1¼ in. from the end of a rail and fully developed fissures 7½ in. from the end. They have occurred in some of the best track in the country and in some of the poorest, and at all seasons of the year.

So-called shattered zones have been found in rails of the harder grades of steel, located in the central part of the head or base or at junction of the base and web, but these zones do not extend to the hot-sawn end of the rails. A definite relation between these shattered zones and transverse fissures has not been established, but transverse fissures have been found with their nuclei located in the sound metal between such shattered zones.

In addition to the known facts reviewed in the text of the report the diagrams bring out three things which have not been so clearly indicated before. They are: (1) That certain heats seem to be more subject to failures by transverse fissures than others. (2) That on practically every railroad submitting reports on this type of failure, the failures seem to be grouped in certain geographical positions, so that in any one piece of track the failures will occur at certain mileages in considerable number while at other mileages there will be few or no failures. (3) That rails rolled by certain mills in certain years are much more subject to failure by transverse fissure than rails rolled in other years. This latter condition is emphasized by the fact that the reports from different railroads show similar conditions for corresponding years. For example, for the year 1910 Bethlehem rails on both the New York Central and the D. L. & W. show an unusually large number of failures.

Year of Rolling—As to failure of rails in the same year, the author says that at least in the case of the Great Northern Ry. the rails which displayed transverse fissures in large numbers were very hard rails in respect to chemical composition and were intended to offer great resistance against abrasion. He adds that: "Notwithstanding the doubt which has been expressed in regard to certain years' rollings, no identification of defects has been announced upon which the belief is founded. In due course of time it will be of interest to see whether those years of mistrust occupy a certain place in regard to the calendar, or whether they advance and maintain a more tangible relation to traffic conditions."

No deductions are made by the author from the fact that failures by transverse fissures are concentrated at certain locations in the track on the sections of railroads used for the tabulation. Nor does he add any data to show whether this feature is merely the result of physical conditions such as might occur on the inside of sharp curves with high elevations, or whether the personal factor is responsible, or whether rails from heats which seem to be subject to transverse fissures were concentrated at those points.

In his review of the facts concerning transverse fissures the author discusses each one in its relation to the various hypotheses of their formation which have been advanced since his discovery and discussion of this peculiar type of failure in his report on the Man-

chester wreck in 1911. The ingot position of the rail as a primary cause is eliminated by the fact that failures occur in rails from all parts of the ingot; age is eliminated by the fact that transverse fissures have developed in rails a few months and many years old. He questions the evidence that rails rolled in certain years are more subject to transverse fissures, and says that the evidence is not sufficient to show that the fissures are due to other than unusually hard steel or to density of traffic.

Causes—Mr. Howard states that certain heats display greater durability than others. He points out that the internal strains due to cooling and gagging are shown to have little possible effect on the formation of transverse fissures, that the so-called shattered zones are probably the result of cooling strains, and that although there may be some connection between transverse fissures and shattered zones the fact that transverse fissures have been found in the sound metal between two shattered zones would seem to indicate that they were due to some other cause. The cause of transverse fissures is, he thinks, the internal strains set up in service by the cold-rolling effect of the wheels. The result of this cold rolling is to set up intense strains of compression in the shallow zone of metal at the top of the rail which develop a counterbalancing tension on the central part of the head. The strains of tension find relief in the formation of transverse fissures, but this is temporary, and as the cold rolling continues similar strains are built up in the adjoining metal until other fissures occur. This formation of two fissures in close proximity would be impossible under the action of bending stresses alone. The author then proceeds to show how in laboratory tests transverse fissures have been produced under conditions approximating field conditions. Track stresses as a primary cause are also eliminated by the fact that transverse fissures have occurred in all weights of rail and on all kinds of track.

The report draws attention to the fact that transverse fissures are practically unknown on English and Continental railways and points out that from what is known of the manufacture of foreign rails and the conditions of their acceptance, it does not seem probable that the practical immunity from transverse fissures is due to superiority of the metal used. The moderate wheel loads are a significant factor.

In his concluding remarks the author says:

Three features constitute the rail problem: (1) Girder strength; (2) Abrasive resistance to the action of wheels; (3) Cold-rolling effect of wheels on the head of the rail. If the third feature was eliminated, there would be no rail problem, since the requirements of the first and second can be met without difficulty. The third feature is the vital one, and admits of solution in one way—by the proper regulation of wheel loads. The effect of wheel pressures, as they are received by the zone of metal at the top of the head, constitutes the essence of the rail problem. Internal strains which tend toward the formation of transverse fissures are acquired by all rails. Selection of the proper grade of steel and the regulation of wheel loads constitute factors for meeting their influence.

Inasmuch as the adjustment of wheel loads, according to the ability of steel to endure them, is not a flexible matter, it is left to ascertain what grades of steel possess maximum durability under current track conditions.

It is reasonable to believe that a specific and remediable cause may be found for the failure of some rails, notably those which fail prematurely, revealing whether abnormality resides in the steel, in the tracks, or in the wheel pressure. It is questionable whether increased weight of rail, far beyond the heaviest now being rolled, would overcome the destructive effect of these fissures.

* * *

Rock Island Results Not In Entire Accord

By C. A. Morse

Chief Engineer, The Chicago, Rock Island & Pacific Railway Co.

IN ORDER to study transverse fissure rail failures on the Chicago, Rock Island & Pacific Ry. in their relation to traffic density and to axle loads, we have superimposed the data concerning transverse rail failures upon a tonnage diagram.

A study of this diagram shows that the transverse fissures have predominated with us on 100-lb. rail in our heaviest traffic territory, but it also shows 19 transverse fissures, four heats of which had three or more transverse fissures develop, occurred on our Arkansas Division in a territory where we have single track and where the combined east and westbound traffic is a little more than 9,000 tons a day. It also shows on that same division two transverse fissures where we had about 8,000 tons per day, but the point where we had 34 transverse fissures was on our westbound track with 18,000 tons a day; 25 fissures on our eastbound track where we had 22,000 tons a day, and 16 fissures on a single track where we had nearly 23,000 tons a day on one track, yet just adjoining this last piece was a stretch of 32 miles, 22 miles of which were single track, on which we had nearly 25,000 tons passing over the one track with no failures.

This would indicate possibly what Mr. Howard contends—that the majority of the transverse fissures are on heavy traffic lines and that heavy rail does not prevent them; but I do not think that the diagram substantiates Mr. Howard's claim with reference to heavy wheel loads as our lines between Chicago and Rock Island, where we have the most business and the most transverse fissures, has a lighter axle load than much of the territory west of that where we have developed transverse fissures, and on our Arkansas Division east from Memphis, where we show 21 transverse fissures, one section having an axle load of 53,000 lb. and the other 45,750.

* * *

Density-of-Traffic Theory Not Supported on El Paso & Southwestern

By J. L. Campbell

Chief Engineer, El Paso & Southwestern System

THE THEORY that the transverse fissure or its incipiency is not in the rail when laid but is made in its incipiency and its development by the rolling of the wheels on the rail, is unsupported by satisfactory evidence. Mr. Howard says that the number of transverse fissures is greatest on those roads where the traffic is heaviest, and appears to conclude from that that the theory above described is correct. Is this theory supported by observation of the fact, if it exists, that the greatest number of rail failures through transverse fissures observed to occur on tracks carrying maximum traffic are uniformly distributed throughout the length of such track and as between all kinds of rails on that track? The theory needs the support of observation.

On the El Paso & Southwestern, a line of comparatively light tonnage but approaching the maximum in speed and axle loads, we have had only one definite instance of pronounced trouble with the transverse fissure. This occurred on 25 miles of 85-lb. open hearth Bethlehem rail laid in 1908 and removed in 1921 on acount of continued rail failures, all of which showed the transverse fissure normally located in the center of the head. The first failure occurred shortly after the rail was laid, derailing a light special train running 50 miles an hour, the rail breaking into six pieces and all fractures showing the fissure. The last failure was a

few months before the removal of the rail began. Except as the rails removed may have had incipient or developed transverse fissures, of which there was no indication on the surface, they were all in excellent condition and adequate for continued service.

East and west of and connecting to this 85-lb. rail was rail laid on the east in 1909 and 85-lb. rail laid on the west in 1912. From these dates until the 85-lb. rail failing through transverse fissure was removed from the track, all of the 85-lb. rail on that district carried identically the same traffic but no trouble from transverse fissures developed in the rail laid in 1909 and 1912. The latter rail is still in the track and in good condition.

* * *

Should Improve Rail to Meet Present Requirements

By C. R. Harding
Consulting Engineer, Southern Pacific Co.

JAMES E. HOWARD'S latest contribution to our knowledge of interior transverse fissures in steel rail is a remarkable step toward the final solution of this old and baffling problem.

One thing which has gone far toward maintenance of railway service at low rates in this country is the operation of heavy units of power and long heavily loaded trains. The material at present available for steel rails is in some way deficient, when it comes to resisting cold rolling strains due to heavy wheel loads.

There will probably be larger and better units of power and equipment developed in the future, but it would seem prudent to pause for a while, in the matter of unit weights, to permit rail steel to catch up with present-day requirements.

The field is wide open for our metallurgists, to discover a material, method of manufacture or method of heat treatment which will provide proper resistance to cold rolling effects without detriment to other functions demanded of steel rails. The Southern Pacific Co., for one, following its practice of long standing, would undoubtedly purchase liberal amounts of rail of a material which seemed to promise the above results. As a large user of rails this company would thus encourage the manufacturers to help toward the desired end.

* * *

Geographical Distribution on the Canadian Pacific

By J. M. R. Fairbairn
Chief Engineer, Canadian Pacific Railway Co.

AS THE 39 transverse fissures on the Canadian Pacific were distributed over all the districts on both Eastern and Western Lines and came from 17 different divisions, 20 different subdivisions, and 32 sections it is apparent that they are not seriously bunched geographically and that our campaign to educate the section foremen to recognize a transverse fissures has been effective. The information is not offered as a refutation of the statement that transverse fissures are bunched geographically on other railways, but is simply a statement of the facts as they have so far developed on the Canadian Pacific Ry.

I am convinced that if we are not now securing reports on all of our transverse fissure failures we are at least securing reports on the great majority of them and that no considerable number escape identification. We are, however, continuing our educational campaign.

Columbia River Bridge Tolls

Tolls from the bridge over the Columbia River between Portland, Ore., and Vancouver, Wash., totaled $224,223 for the first nine months of 1923, according to a report of the Interstate Bridge Commission. This exceeds the figures for the corresponding period last year by about $49,000.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

A SERIES OF ARTICLES on Federal Land Reclamation is now running in *Engineering News-Record* the second article appearing in this issue.

The purpose of the series is to give a history of the twenty-one years of government irrigation, state the many problems of operation—engineering, agricultural and financial—analyze the various complaints that are being so emphasized by those who are seeking a reform of the current law and methods and seek to present some views as to a constructive policy in the future. Through it all will run the evident theme that irrigation, from planning, through construction to operation, is a continuing engineering problem.

As a part of the preparation of the series Mr. Schmitt is now traveling through the West, visiting irrigation projects, studying developments and interviewing builders, operators and settlers. He is writing this series of letters of running comment on the situation as he sees it on the ground. These are not the final result of his trip but they will serve to acquaint our readers with the actualities of reclamation as revealed to an unprejudiced investigator.

This is the fifth letter. The first appeared in the issue of October 4.—*Editor.*

San Francisco

INTERVIEWS with bankers and other men informed about financial conditions among the farmers on reclamation projects bring out the fact that these farmers have money troubles. They are heavily in debt, have not been finding it easy to pay interest, and want more credit.

Financial Difficulties—On several northern projects the mortgage indebtedness on the farms averages $40 to $70 per irrigable acre of the whole project. Most of this is in real estate mortgages at 8 to 10 per cent; the rest is in chattel mortgages at rates up to 12 per cent. There are also crop obligations every season, not included in the above. Thus a yearly interest charge of $5 to $7 has to be paid out of the earnings of each acre. The average gross production of the projects, however, is sometimes as low as $25 per acre, and does not exceed $50 under favorable conditions; in fact, the best one of these northern projects produced only $48 per acre as the average of the last seven years, and only $27 in 1922, a year of abnormally low prices. Out of such earnings as this the farmer must pay all costs of production and in addition must pay $2½ for taxes, $1½ to $2 for water, $5 to $7 for mortgage interest and $1 to $4 for construction-cost installment; and he ought to have enough left to pay him a wage for his labor.

One might figure that the farmer doesn't need a wage, that he gets a living out of his farm over and above the reported crop production. Doubtless many farmers do; but on one project, at least, town store people have remarked with surprise on the number of farmers who buy eggs, milk and other food supplies that they should raise on the farm—and of course this means more money to be taken out of the crop sales.

With such a narrow margin between income and outgo as these data indicate, the farmer is pinched in the ups and downs of crops and prices. When heavy crops and good prices come together he can make some money, but unless he is prudent enough to save for

future losses, the lean years may ruin him. All the time it is mainly the mortgage debt burden that keeps him down in the mire.

Farm finance is one of the biggest elements of the reclamation problem, in fact. The Congressional relief acts and departmental postponements of charges, where they have been of any use at all, have not touched the matter of getting and keeping the farmer out of debt, or (on the principle that a certain number of fleas are good for a dog) down to the desirable amount of debt.

The expense of pioneering has largely been worked out on the reclamation projects. The heavy debt burden did not come from this expense but from the ballooning of land values four or five years ago and the resulting land speculation. The poorest projects were least hit by this inflation, and are least in debt now.

Bankers admit quite freely that they were carried away in the short post-war boom; they admit that they loaned far too freely, loaned too much per acre, and helped along the value-inflation. There were shoestring purchases of land, where most of the small cash payment was raised at the bank on first mortgages and the seller took a second mortgage for the bulk of the price, a proceeding which imperiled all three parties. Much land changed hands at valuations on which it could never pay except with abnormally high prices for crops and these prices collapsed soon after the boom in values. The bankers' ideas of land values were quite as optimistic as those of the farmers. Bankers as well as farmers have been paying the penalty during the last three years.

Land Values and Government Equity—One might suspect some fundamental flaw in the habits of mind that allowed these effects to come about, and such a flaw appears to exist, in fact. There is a peculiar thing about land values on reclamation projects: they take no account of the government's equity in the property. The unpaid construction charge is simply disregarded. Farmers buy and sell without regard to this equity, tax assessors make their valuations in the same way, and bankers loan in the same way. Only the Federal Land Banks deduct the government equity from appraised clear value (and then loan up to half the remainder). Though they have been operating for only about a year on the reclamation projects, they are helping to make other bankers' ideas sound. But even now a certain bank that is called conservative has loaned without question nearly twice as much per acre as the Federal Land Bank limit for the particular reclamation farms concerned, and this in cases where the Land Bank absolutely rejected the loan on account of its moral hazard.

One natural result of basing credit operations on such loose-thinking is that the government equity comes to be considered unreal, or is forgotten; and a secret feeling springs up that in all fairness the Reclamation Service ought to forget it also. But another result, and perhaps a more serious one, is that the settler is enabled to cash in on the full land value, and thinks he is justified in doing so, despite the fact that he is appropriating an element of value which the nation at large created, a loan not yet paid. In thus putting the government equity into his own pocket when he sells, he burdens the purchaser with an extra debt, usually on top of an already inflated land value.

The individual settler cannot be blamed greatly for such actions, since they are in line with the general practice in his community. The blame properly rests on the system of the law or its administration. If the main objective of reclamation is the development of stable farm-home communities, the farmer should have full right to the productive value which his labor develops in the land, but he should be prevented from trafficking in the value created by the government's irrigation enterprise until after he has paid for it. The California State Settlement rules contain safeguards for accomplishing this but federal reclamation practice lacks them. I understand that a first attempt in this direction is about to be made in a new contract form devised for the Yakima project.

Speculative Selling and Settling—Besides the speculative element in selling and loaning on the reclamation projects, there seems to be a large speculative factor in the original settling. Farmers, bankers and irrigation operators in private as well as in government service have told me that a large number of the settlers, probably more than half, come originally with the main idea of getting something for nothing. Some of these speculative settlers farm, some few farm well; but many become absentee landlords, and either let their land lie idle or have it farmed, after a fashion, by renters. Some projects are spotted with such idle or poorly farmed units, and it is not specially comforting to learn that this piece is held as a speculation by a former United States senator, or that one by a slipshod town garage man, neither of whom will ever get into the farm-home class. If resale were hindered until after the government equity is paid for, possibly there would be fewer speculative settlers.

From the figures given as to the farmer's debt and payments it can be seen very clearly that the water charge and the construction charge are *not* the things that make or break him, as might be thought from some of the grumbling at these charges. No feasible reduction of these charges would save the farmer who by lack of skill or unthriftiness is going down, and no ordinary increase would wreck the one that is making a success. But the farmer sinking under the excessive weight of his debts will grasp at the straw of the government charge.

A Continuously Moving Railway

A "never-stop" railway, a new type of line for local passenger traffic, in which a number of small independent cars are moved by a longitudinal screw with varying pitch of thread, is being exploited in England and is a development of a scheme invented in the United States many years ago. At stations the pitch is small so that the cars move slowly and passengers can step in and out; beyond the stations the pitch increases gradually to the maximum for high speed. A short line has been built in an amusement park at Southend by the Never-Stop Transit Co., Sardinia House, London. The cars are operated independently instead of in trains, and each has beneath it an attachment with rollers engaging the thread of the screw between the rails. This screw or shaft is carried in ball-bearings and is rotated at constant speed by means of motors which may be as much as 1,200 ft. apart. For this system it is claimed that it requires no signals, brakes or trainmen.

Water-Works Dam Withstands Record Flood

Oklahoma City Structure Passes Almost Five Times Designed Capacity, Though 250 Ft. of Corewall Fails

FLOOD waters that reached a peak toward midnight of Oct. 15 and which, it is estimated, more than doubled the June record flow in the North Canadian River at Oklahoma City, Okla. (see *Engineering News-Record*, Aug. 23, p. 292), poured over the city water-works dam with a maximum height of 27 in. over the dam crest, inundated all the surrounding country, and finally scoured the downstream face of the corewall until a section about 250 ft. failed, emptying the reservoir without damage to the dam, except slight injury to the handrail in one or two bays, replacement of which cost about $50. It is estimated that at least 65,000 sec.-ft. of water passed over the dam and through the control works, though the designed spillway facilities, depending upon the head, are from 12,000 to 15,000 sec.-ft. Other damage to the water-works, all of which it is estimated will cost $1,200,000 to repair, include the loss of gunite slope paving to the reservoir of two 500-ft. sections and the carrying away of about 500 ft. of the bypass embankment at the upper end of the bypass canal.

The general property damage to Oklahoma City through the flood, caused by excessive rains, will approximate $2,500,000, not including the damage to the water-works. Report of the flood and damage to the water-works is given by V. V. Long, consulting engineer of Oklahoma City, who made an examination of the works and prepared a report at the request of *Engineering News-Record*. His report follows:

SURFACE CAR TRACK TORN UP

The year 1923 has made flood history for Oklahoma City. The yearly rainfall has been to date 42.5 in., while the average yearly rainfall is 31.5 in. Yet during this year there have been four floods of the North Canadian River, with stage heights and estimated maximum flow as follows:

May, 15,000 cu.ft. per second; June 13, 33,000 cu.ft. per second; September, 12,000 cu.ft. per second (height 14 ft.); and Oct. 15, estimated, 60,000 cu.ft. per second. The maximum flood of record previous to this year was 11,000 cu.ft. per second, in October, 1920.

The North Canadian River has a long, narrow valley with a tributary drainage area of 10,000 square miles above Oklahoma City. Preceding the recent flood, the rains began Friday, Oct. 12 and lasted through Monday, Oct. 15, during which time 5.29 in. had fallen in Oklahoma City. The rainfall west of Oklahoma City, up the river valley, was even heavier than at Oklahoma City.

The flood crest first manifested itself at Woodward, Oklahoma, on Oct. 13, thence it passed rapidly down the valley, reaching El Reno, forty miles west of Oklahoma City, Sunday afternoon, Oct. 14, and the Oklahoma City reservoir, seven miles above Oklahoma City, before midnight, Oct. 15. At 9:25 o'clock p.m. the earthen embankment at the west end of the dam gave way and the resulting flood wave crest passed through Oklahoma City from 11 p.m., Oct. 15, to 3 o'clock a.m., Oct. 16.

General Damage—The damage to railroads, street railway and highway can be best appreciated by the fact that no traffic of any kind was able to cross the North Canadian River from midnight, Oct. 15, until Robinson Avenue was re-opened at 4 o'clock p.m., Oct. 18.

The street railway lost all three of its bridges, together with probably two miles of track and fills. The bridges were all pile trestles, one of which had been carefully replaced after the June flood.

AIRPLANE VIEW OF OKLAHOMA CITY AFTER FLOOD
Water had fallen about 3 ft. when this view was taken.

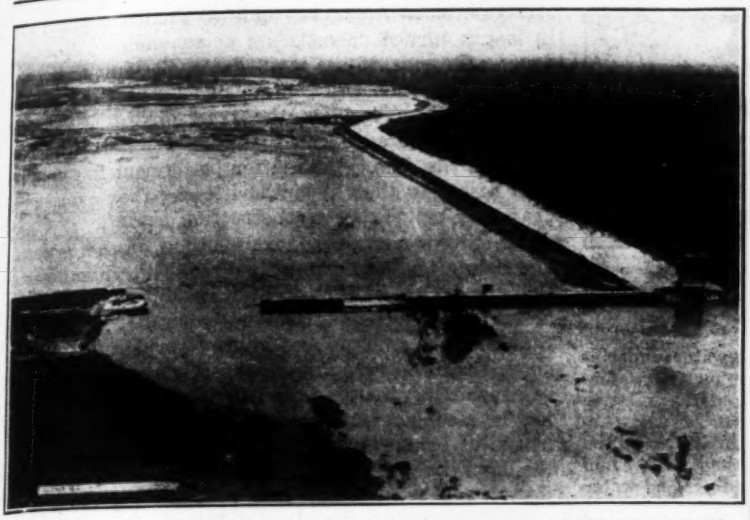
The Santa Fe R.R. bridge, a steel span with pile trestle approaches, stood the flood with water several feet over the track, but the railroad embankment at both ends went out for a total length of approximately one mile.

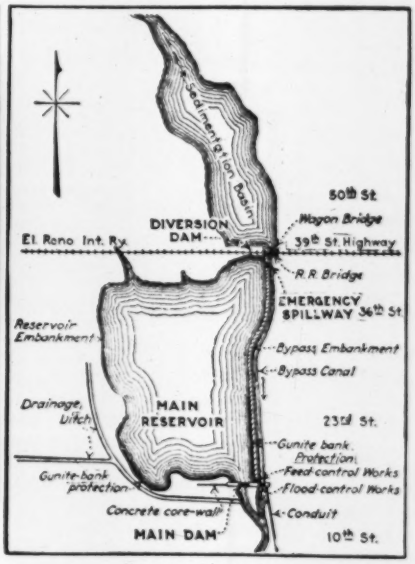
The Frisco R.R. lost two pile trestle bridges and several miles of track as the heavy current of the flood passed through their east yards.

The Rock Island Railroad lost its pile trestle bridge west of the city, but the steel spans of both the Rock Island and M., K. & T. railroads east of the city stood the flood, although considerable track of both lines went out.

Damage to Water-Works—The Oklahoma City water supply suffered probably the largest damage; however, there has been no interruption of service. The water lacked only 6 in. of reaching the pump and boiler room floor levels.

The Oklahoma City water reservoir covers 1,700 acres with a storage capacity of 7,000,000,000 gal. and is formed by an Ambursen dam 54 ft. high above shale, across the North Canadian River, about seven miles above Oklahoma City. At the west end of the dam, a concrete corewall resting on sheetpiling driven to shale, extended from the end of the Ambursen structure some 500 ft. westward. Around the south and west sides of the reservoir west from the dam an earthen fill varying from zero to probably 6 ft. in height was thrown up for a roadway to an elevation uniformly equal to at least 12 in. above the walkway on the Ambursen dam, which walkway is 6 ft. above spillway of the reservoir. For over 6,000 ft. west from the west end of the dam the reservoir banks are protected with gunite slope paving 3 in. thick, with a 4-in. gunite wall, the top of which comes up to an elevation 12 in. above the walkway on the dam. This same protection extends for over 4,000 ft. along the reservoir side of the





AIRPLANE VIEW (AFTER FLOOD) AND PLAN OF DAM, RESERVOIR AND BYPASS

bypass embankment which follows the east side of the main reservoir.

The bypass canal is 120 ft. wide at its base with 2:1 slopes and is approximately two miles long, with an 18-in. fall. The embankment between the canal and the main reservoir is protected with good 12-in. riprap on the bypass side, and with the gunite on a 2:1 slope on the reservoir side.

The bypass was originally intended to carry all flood waters by the reservoir through four gates 9 x 14 ft. and a spillway 72 ft. long by 5 ft. deep at the east end of the main dam. These are computed as having a carrying capacity of 12,000 cu.ft. per second. There is an emergency spillway from the bypass to the main reservoir near the upper end of the bypass, which together with the gates to the main reservoir at the lower end of the bypass have a normal capacity of 9,000 cu.ft. per second. Near the west end of the dam there are four gates 4 ft. by 5 ft. and a spillway 144 ft. by 6 ft. deep through the Ambursen dam out from the main reservoir to the river below. The total flood capacity through the dam from both bypass and reservoir is between 12,000 and 15,000 cu.ft. per second. The June flood of 33,000 cu.ft. per second topped the walkway of the dam, throughout its entire length of 1,200 ft., 6 in. deep, but the gunite slope protection west from the dam, being 12 in. above the walkway of the dam, held the flood waters, and very little damage was done.

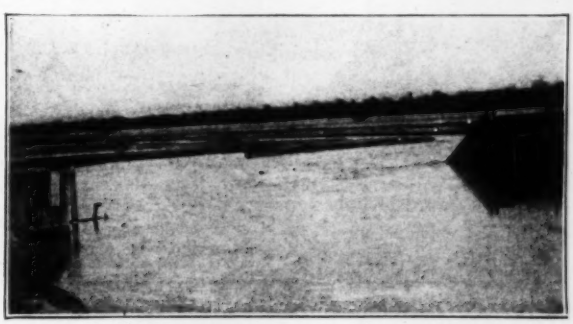
Bypass Embankment Broken—The flood burst through the bypass embankment into the main lake at about 5 o'clock p.m. just below the emergency spillway, carrying away about 500 ft. of the bypass embankment and filling the reservoir. The water kept rising until at 9:25 p.m. it was flowing over the walkway of the dam 27 in. deep, and was therefore 15 in. over the gunite slope protection and earth embankment west of the dam. At 9:25 p.m. the break occurred in the corewall adjoining the west end of the dam, when approximately 250 ft. of the earthen bank and corewall gave way. While it is not known just how the break started, as it was dark and raining, it is thought that the water, flowing over the gunite and embankment, carried away the earth below the corewall, which then failed due to the pressure from above.

At about 5 p.m. both the street railway and the highway bridges at Thirty-ninth Street across the upper end of the bypass went out, and while every effort possible was made to catch all the debris therefrom, a portion of these bridges came down the canal and lodged in the gates and bypass spillway under the walkway, thus cutting their capacity down to probably 40 per cent of their rated capacity. Another portion passed into the main reservoir through the break in the embankment, and coming on through the reservoir, lodged in the main reservoir spillway under the walkway.

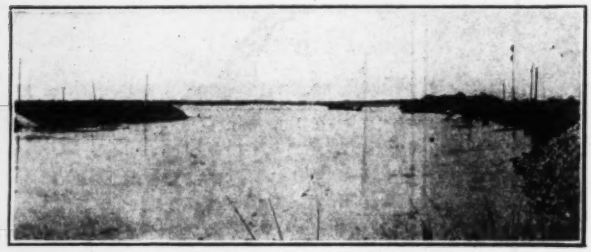
Failure of Gunite Protection—The gunite slope protection has stood the test with two exceptions, both of which are on the bypass embankment. At one place it is evident that something has hit the top of the wall, possibly a part of the bridges coming down from Thirty-ninth Street, this crushed some 500 ft. of wall. Near the dam, about 500 ft. of the gunite on the bypass embankment slid down after the water drained out of the main reservoir. It is quite evident that this was caused by the saturated bypass embankment which was not stable on a 2:1 slope.

It is not known how much the reservoir capacity has been cut down by silting up due to the flood passing through, as this can only be determined by soundings and surveys.

These floods have shown that the bypass canal and the spillway and gate capacity of the dam are woefully inadequate.



BREAK IN COREWALL; NOTE POINT AT WHICH IT JOINED DAM, WHICH WAS UNDAMAGED



UPPER END OF BYPASS CANAL

Both highway and interurban bridges, latter the El Reno Int., were washed out.

The writer is indebted to C. E. Bretz, water superintendent of the Oklahoma City water-works, for the water-works pictures, and a large part of the information relative to the floods and reservoir failure. Mr. Bretz was personally in charge of the work of attempting to save the reservoir and worked heroically, almost without rest, from Saturday to Tuesday, and by his untiring efforts the water service in Oklahoma City continued without interruption. The writer is also indebted to Warren E. Moore, Commissioner of Public Works of Oklahoma City, for the information relative to the situation in the city.

Mr. Stewart's Report—Spencer W. Stewart, president of the Ambursen Construction Co., engineers and builders of the Oklahoma City water-works dam, arrived in New York Oct. 29 after a special trip to Oklahoma City to inspect the dam. At the time of the flood his company was engaged upon a redesign of the dam, made after the June flood, which was to take care of a maximum flow of 63,000 sec.-ft. over spillways and through flood-control gates. The contract for this extension was made Sept. 15. The increased flowage was to be secured by opening eight bays in the dam at about a third of the way from the east end of the dam and placing crest gates, and by lowering the crest level in the existing ones. Four more gates of the same size as will be placed in the dam will be placed in the bypass spillways, thereby allowing for a maximum flood discharge there of 18,000 sec.-ft. The gate-controlled pass at the upper end of the bypass will be opened to pass into the main reservoir a maximum of 50,000 sec.-ft. from the sedimentation basin. These improvements will be carried forward.

Closure of the gap, resulting from the failure of the corewall, will be made, asserts Mr. Stewart, by the construction of an Ambursen spillway section about 350 ft. in length turned downstream at an angle of about 20 deg. to the axis of the main dam. Besides large crest gates this section will contain two 12x12-ft. caterpillar gates which will allow the reservoir to be emptied quickly and in advance of any flood waters that may threaten the dam. This latter betterment is contained in a report to the city authorities by the engineers in charge of estimating reconstruction needs.

BYPASS SPILLWAY AND GATEHOUSE

Debris clogging spillway and gates is partly timber from bridges at upper end of bypass canal.

Mr. Stewart made an examination of the reservoir and dam after flood waters had receded and he asserted that the failure of the corewall was due to the scouring of earth downstream from the corewall. He also said that both the railroad and highway bridges at 39th St., above the dam, were underscoured, part of the highway bridge hitting the dam near the flood-control house being in a single section about 250 ft. in length. This length of bridge was practically intact when it reached the dam, the pile bents, decking and flooring all remaining as one self-contained section. As it hit the dam part of it rose in the air and turned over on the dam crest. Mr. Stewart said the failure of the gunite was perhaps due to the fact that with the reservoir water level much lower than that in the bypass canal after the corewall failed, seepage through the bypass embankment tore the gunite out, the hydrostatic pressure being too great for it to resist.

Dissolves Cement Manufacturers Protective Association

Judge in New York District Court Says Open Price Association in Eastern District Was in Restraint of Trade

JUDGE John C. Knox, of the United States District Court, Southern District of New York, on Oct. 23 ordered dissolved the Cement Manufacturers Protective Association as an illegal combination in restraint of trade. This was a decision in a suit in equity, brought by the United States requesting a decree dissolving the association.

The Cement Manufacturers Protective Association was formed in January, 1916, with a membership of eighteen portland cement companies operating in the Eastern states. Similar associations were also formed in different sections of the country. It should be noted, however, that none of these associations has any connection whatever with the Portland Cement Association, which is an association of practically all the cement companies in the country for technical purposes. According to Judge Knox's statement in the case, the Eastern association was formed with the following clause in its constitution:

> The objects of the association are the collection and dissemination of such accurate information as may serve to protect each manufacturer against misrepresentation, deception and imposition, and enable him to conduct his business exactly as he pleases in every respect and particular, free from misdirection by false or insufficient information concerning the matters following, to wit—(a) information concerning credits; (b) information concerning contracts which have been made for the delivery of cement, sufficiently complete to enable the manufacturer to protect himself against spurious contracts and like transactions induced by misrepresentation; (c) information concerning freight rates on cement; (d) statistical information as to production, stocks of cement and clinker on hand, and shipments.

Association Activities—The judge then goes on to outline the operations of the association. He states that it undertook the collection and distribution of information on accounts outstanding, bills receivable, accounts in attorney's hands for collection, contracts made and in effect, contracts cancelled, a statistical statement of production and shipments during the preceding month and stock of cement and clinker on hand, and finally the preparation and distribution among members of a complete schedule of freight rates on cement, giving rates for rail, water, and rail and water shipments. Judge Knox then calls attention to the so-called "specific job" contracts, which are agreements whereby a manufacturer is to deliver in the future the cement to be used in a specific work, such as a particular building or road, and the obligation is that the manufacturer shall furnish, and the contractor shall take, only such cement as is required for or used for the specified purpose. In the year 1921, such contracts covered about 30 per cent of the annual cement production of all the defendant corporations.

Reference is then made to the bag-refund practice common among all cement companies and to the practice of basing all prices on a common mill basis.

In commenting upon the various procedures, the judge calls attention to the use of the freight rate books. He said that the publication of freight rates is obviously harmless, but that their vice resides in the fact that there is a concert of action upon the part of defendants in so using them that all prices quoted are for delivery at the point required by the purchaser, and that no cement will be sold in such manner as will permit a purchaser to take advantage of cheaper transportation charges than are required to be paid for the shipment of cement by rail. In extenuation of the practice, it was claimed that this method of marketing cement is a trade custom which came into being before the formation of the association, and is in no way to be attributed to agreement or any activity of the association.

Similarity to Early Association—The Judge says: "Very probably there is no agreement now in force by which such practice is to be followed. The custom, however, was at one time the subject of an agreement to which thirteen of the corporate defendants were parties, namely, the Articles of Association of Licensed Cement Manufacturers, dated June 30, 1909. This agreement, whatever may have been the justification for its existence, obligated each licensed dealer named therein to observe certain practices, which if they were now the subject of contract, would without doubt entitle the government to the relief sought. It is not without interest to note the similarity existing between the uniformities and facilities now availed of by defendant corporations, and the practices observed by a number of them under the license agreement, which seem to have then been regarded as helpful, if not essential, in an endeavor to maintain prices and to apportion territory."

Judge Knox then cites a number of extracts from the proceedings of the association which, in his mind, tend to show that the object of the statistics was to provide each manufacturer with information regarding the business of the other manufacturer so that there would not be any wide variation in prices. The companies wanted to know the prices that the other companies paid for returned bags, which seemed to the judge to be an indication of the possibility of rebate in this system which the association was anxious to prevent. He criticises further, somewhat mildly, the specific job contract prices, which he thinks were mainly to make assurance doubly sure that over any future time there would be no "free cement."

He devotes some attention to the contention of the defendant that in such a commodity as cement, uniformity of price is bound to result in an open market, but he contends that in the cement industry, where there is a marked difference in production cost, in the financial necessities of manufacturers, in the location of mills as respects active markets, and where there is less than a capacity production by all manufacturers who desire to sell cement, it is reasonably to be expected that there will be a difference in the inducements to be offered to prospective purchasers. He said that in a purely competitive market, producers would not be content with a situation wherein the field of competition was limited to the personality of the salesman, which is, the judge believed, the case in the cement business today.

Judge Knox admits the contention of the defendant that ignorance is not a virtue and knowledge and information are not a crime, but he says that in this case the sources of wisdom and knowledge are not open to all interested persons upon more or less equal terms, and that the customers were not possessed of the same information as the producers were.

Summary of Ruling—Finally the judge concludes in the following words:

> There is, I take it, no need to find that the prices at which defendants sold cement during the period over which the association has functioned, were excessive. Indeed, as compared with the rise in the prices of other basic commodities, it is possible to say that the quotations of cement advanced less than others. Nor can it be said that the association overcame and destroyed all competition between the defendant manufacturers; upon many occasions, they were active in an endeavor to take business from companies associated with them. In some instances, they undoubtedly offered inducements to purchasers and thus secured orders that otherwise would not have been obtained.
>
> But, upon the whole, and without further discussion of the great mass of evidence which goes to make up this record, I think that real competitive effort tended to become more and more feeble, that manufacturers by reason of the exchange of statistics, were equipped to regulate their production, and by common consent and a concert of action, did so, to the end that the cement supply would at all times be a lap or two behind the demand, and thus created higher prices. In enabling this to be done, the association, its officers and agents, together with its membership, materially limited the full and free operation of the contending forces of competition to which the public, under the Sherman Law, is entitled, and unreasonably affected interstate trade and commerce.

In conclusion then Judge Knox states: "The government may have the decree for which it asks."

Changes Made in Washington Warehouse

The reference to the refrigeration in the article on the Terminal Refrigerating & Warehousing Co.'s warehouse in Washington, on p. 633 of the Oct. 18 issue of *Engineering News-Record*, should read "Refrigeration is provided by four compound motor-driven ammonia compressors which produce 450 tons of refrigeration; 1,100 hp. is required to operate the plant when running at full capacity, including elevators and all miscellaneous machinery." Plaster was applied to the insulation work with a trowel instead of a cement gun as originally proposed.

Structural Lessons Learned from Survey of Steel-Frame Buildings After Japan's Earthquake

Wilbur S. Sample, Engineer for Fuller Co., Inspects and Reports on Condition of American-Built Structures in Tokyo—Recommends Design to Resist Shocks

JAPAN'S earthquake of Sept. 1 failed to destroy—although it damaged slightly—the three large steel-frame office buildings which the George A. Fuller Co. of the Orient, a subsidiary of the New York firm of the same name, built in Tokyo a year or two ago. After the quake Wilbur S. Sample, engineer for the Fuller organization in Dairen, Manchuria, went to Tokyo and on Sept. 19 and 20, in company with Japanese architects and engineers, he inspected the N. Y. K., the Japan Oil and the Marunouchi buildings, all steel-frame structures seven to eight stories high. A thorough examination was made of the damage resulting from the earthquake, extending to every part of each building, from basement to roof inclusive, that could be seen without further demolition of standing work. The following report covers Mr. Sample's findings and recommendations for the first two buildings above named, a separate report on the Marunouchi building being substantially the same as the one below quoted. Additional data from the Marunouchi report are included in brackets. Otherwise the text below applies to all three structures:

Structural Steel—The steel frame in every case seems to have been of sufficient strength to withstand the dead loads and the sudden application of any superimposed loads due to vibrations caused by the earthquake and also seems to have shown a sufficiently high elastic limit to have returned to its original position in every case. That there was undoubtedly a marked momentary deflection laterally in the columns is evidenced by the shattering of a large percentage of the masonry piers surrounding or enclosing the exterior wall columns and of the plastered partitions between the steel columns of the interior. While the momentary and violent deflection of the columns laterally, particularly in the second and third stories, was of sufficient strength to shatter the enclosing or contiguous masonry, the agitation was not sufficient permanently to distort the columns in any case.

[In the Marunouchi Building the report notes "the distortion or destruction of the steel cross bracings which were added to the structure after the earthquake of 1922."]

Reinforced Concrete—Except where the principal bays or sections of the parts of each building joined together, such as the front wings or the side wings, there was no evidence of any destruction or distortion of the reinforced-concrete floor slabs. At the joints between the front and side wings there were some minor cracks in the floor construction showing through the corridor floor surfacing, and indicating that the several sections of the building vibrated independently from each other, the cracks being undoubtedly due to a very severe shearing stress at these points.

Where gravel reinforced-concrete walls were used on the interior and on spandrel walls there was a minimum amount of damage.

[In the Marunouchi Building "there does not appear to be any marked or serious damage to the reinforced-concrete floor slabs or beam coverings. Where reinforced-concrete walls were used on the interior there was a minimum amount of damage except at certain points on stairway walls near the west side of the building. This damage was probably due to the lack of continuity of these walls in a straight line."]

Masonry Piers—In practically 90 per cent of the exterior piers of the second and third [and "fourth," in case of Marunouchi] stories there was evidence of a violent lateral motion or vibration of the entire structure; this extended to a slighter degree to the piers of the first story and of the fourth ["upper," in case of Marunouchi] story. Above the fourth story there appears more or less destruction of exterior masonry but not nearly so pronounced as in the lower stories.

There appears to be no particular kind of facing material outstanding as successfully resisting the crushing and distorting effects of the lateral movement. Architectural terra cotta, cut stone, granite, stucco and tiles showed varying degrees of stability in the order given, the most successful being the last named.

Interior Partitions—The interior partitions in general are constructed of hollow clay tiles, metal lath on steel furring, concrete or reinforced concrete, all plastered on both sides. The hollow tile seems utterly unable to withstand the crushing effect of the lateral movement of columns, as evidenced by the crushing and falling of this class of partitions where the vibration was greatest or in the lower stories. In certain locations where metal lath partitions were used there was more or less damage but this damage was not nearly so pronounced as in the hollow clay tile partitions.

The concrete partitions behaved in a little better manner and the reinforced concrete partitions seemed to be the best of all, but there were some cases of a shattering of these by shearing horizontally along the center line of height, this occurring in partitions built of slag concrete.

Lighting Fixtures—The lighting fixtures in general were of brass canopies with opalescent glass globes, suspended from the ceilings by chain about 2 ft. long. The majority of the glass globes were destroyed by oscillating to such an extent as to strike the ceilings.

Marble Trim and Wainscoting—A portion of the marble finish of walls and columns in the first story was dislodged and destroyed, but as this work was done in the usually accepted manner there can be no thought of faulty workmanship.

In Conclusion

After the San Francisco earthquake of 1906 I attended many meetings of architects and contractors held to discuss various building materials and methods of construction with a view of adopting such as seemed to be the best suited for stability. Practically all of the reconstruction work in that locality was based on designs and materials similar to or the same as those used in Tokyo in recent years, and I believe the Tokyo buildings constructed by your company would have withstood the shocks of an earthquake of the same degree of severity as the San Francisco earthquake, with a minimum amount of damage.

Now comes the Japan earthquake of 1923 with such unprecedented severity and such a tenacity of violence that it becomes necessary for us all to readjust our ideas of construction methods and to adopt such designs and take such precaution as in our belief will provide a greater measure of stability for future structures and a consequent added security for the lives of those occupying them.

With this thought in mind I beg leave to submit for your consideration the following recommendations as to the design of buildings to be erected in locations subject to earthquake shocks:

Recommendations

Foundations—A close observation of the effects of the recent earthquake in Tokyo induces the belief that all foundations should be of friction piles capped with reinforced concrete, isolated pier spread footings, or a solid concrete mat without piles.

In the case of friction piles a number of test piles should be driven of different lengths and in several locations on the lot, each pile tested as to its bearing capacity and each foundation computed from the data thus obtained, allowing

a safety factor of 6 or 7. In no case should the piles be driven to hardpan or to refusal. Each cluster of piles should be capped with reinforced concrete and these caps connected at the top in each direction with reinforced-concrete struts.

In the case of isolated pier spread footings load tests should be taken in several parts of the lot at the proposed level of the footings and the size of each footing computed from the data thus obtained, allowing a safety factor of at least 5. These footings should be connected in each direction with reinforced-concrete struts.

In computing the loads to be carried by either the pile footings or the isolated pier spread footings only the actual dead-load of the structure should be used. No live-load should be figured, or at the least only a very small percentage. Care should also be taken to have the bottoms of all footings at the same level, and deep basements should be avoided.

In the case of a solid concrete mat foundation the mat should be of sufficient thickness and figured for reinforcement to withstand the actual pressure on the ground as determined by computation of dead-loads, and should project sufficiently beyond the outside columns to avoid eccentric loading.

The foregoing recommendations are due to a belief that the soil underlying Tokyo will act as a sort of shock absorber as evidenced by the behavior of such buildings as Seiyukai Building, the Imperial Hotel, and the several other office buildings in Marunouchi. If the foundations or the piling under them are of such length as to reach solid strata then the full severity of the earthquake shock is transmitted through the foundations to the entire structure, while if the foundations rest on a soil of somewhat resilient nature the transmission of shock will be very much less.

Structural Steel—Columns should be placed in straight lines in each direction so that at every panel there will be a maximum number of points of resistance. The sections of columns should be as wide as possible in each direction and should be connected at each floor by girders as deep as the requirements for head room will permit. Both columns and girders should be latticed if the computation of stresses does not require solid web plates. If solid webs are required then the webs should be punched at frequent intervals to permit of the proper application of reinforcing steel as will be hereinafter discussed. Between the girders at each floor will be necessary steel beams for carrying the reinforced-concrete floor slabs.

In cases where head room or clear interior spaces are absolutely necessary then resort must be had to knee braces. It is recommended however that such rooms as absolutely require great height or clear interior be placed on the top story or as near thereto as possible. Rivets for connection of girders to columns should be in shear, wherever possible. Rivets in tension should be studiously avoided.

Reinforced Concrete—In all cases the specification for the mixture for reinforced concrete should be made after a study of the screen analysis of the coarse and fine aggregates available for use. No assurance of success can be had by the adoption of arbitrary proportions for the materials to be used. The water content should also be carefully considered and only a sufficient amount of water used to enable the practical working of the concrete into the forms.

Exterior piers around steel columns should be of reinforced concrete and as large as possible, extending from the frames of openings on each side and from the heads of window frames below to the sills of window frames above.

Interior columns and connecting girders should be entirely covered with concrete, thoroughly reinforced around and through the columns and longitudinally.

Build solid reinforced-concrete walls wherever possible between columns in the interior and also around such places as elevator shafts, stair wells, pipe shafts and vent shafts.

Wherever possible build solid reinforced-concrete walls from basement to roof and from outside to outside walls of building, leaving only such openings as are absolutely necessary for ingress and egress and reinforce the perimeters of such openings in a thorough manner.

Exterior Facing—Avoid the use of brick or stone veneer if possible, using only stucco work or thin tiles. Forming the outlines of projecting cornices, belt courses, etc., as largely as possible in reinforced concrete.

Partitions—If impracticable to use reinforced-concrete partitions the next best in the order named are metal lath on steel studs, solid brick, hollow brick, hollow clay tile. Reinforced concrete is, of course, recommended because of the additional stiffness thereby awarded to the structure as a whole, but if this seems to be impracticable then use metal lath.

Lighting Fixtures—Lighting fixtures should be either indirect system secured flat against the ceiling or should have stiff suspension.

Marble—Use a minimum amount of marble slabs if the marble is to be attached to walls or columns.

Separate Roadways for Commercial Trucks

By Alexander Howard Nelson
Engineer for Atlantic County, Atlantic City, N. J.

On account of the interstate feature of automobile traffic, and probably because of discrimination through the variation in the fees being charged by different states, the whole matter of motor-car license fees might very well be taken over by the federal government and the net receipts distributed among the various states in direct proportion to license values.

Determination of the actual damage done by trucks can very accurately be arrived at by methods somewhat similar to those employed last year in the Bates experimental road tests in Illinois. Having determined damage and used it as the maximum fee, it would be a comparatively simple matter to plot a mathematically correct curve that would disclose, on inspection, the proper license fee to be charged any other truck on solid tires whose capacity and maximum speed were known.

In a similar way, the maximum license fee for trucks equipped with pneumatic tires could be determined and a similar curve plotted that would immediately disclose the proper license fee to be charged any other truck of that class.

The general proposition of having a roadway for trucks separate from the roadway used by pleasure traffic, constructed and maintained from the license fees to be paid on commercial trucks, is practical but it necessarily involves a considerable period of time to bring about, and what is necessary at the present time is immediate relief from the condition in which we find ourselves. The simple expedient is to increase commercial truck license fees, immediately widen most of the present main arteries of travel used by commercial trucks and, at the same time, commence the construction of parallel lines that will be devoted to the exclusive use of truck traffic and such limited, local pleasure traffic as may be necessary.

If it cannot be brought about that the federal government takes over the licensing, controlling and providing for commercial truck traffic, then by all means the various states should promptly determine, by appropriate joint action, a uniform and adequate system of license fees, maximum allowable weight, speed and size, together with an exactly uniform set of rules and regulations controlling all features of commercial truck traffic on public highways.

Commercial trucks which are devoted to strictly local traffic and not in direct competition with railroads should be licensed on a different basis from those which are engaged in long-distance hauling that is in direct competition.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Eccentric Heel Joint

Sir—Summarizing the discussion on heel joints of roof trusses in your issues of Aug. 30, p. 339; Sept. 13, p. 447, and Oct. 4, p. 568, it is worth pointing out that your correspondents, while differing in methods, are practically agreed on results.

Edward Godfrey's solution will furnish accurate values for flat roofs, and it may be committed to memory. However, it will give the direct stresses in reversed direction. This, too, has to be remembered. Formulas, when available, will give quicker results.

Attention should be called to a typographical error in Mr. Godfrey's sketch. The sum of the shears at C and T is $R(p - l)/p$ instead of $R(p - l)/l$. To be consistent, arrow heads at C, T and O should be opposite to that of R.

The assumption, $l_1/I_1 = l_2/I_2$, which Mr. Weiskopf suggests, is a simplification at the expense of accuracy; but in a given case the error lies within control of the engineer.

Bethlehem, Pa., Oct. 11, 1923. CAMILLO WEISS, Structural Engineer.

Slump Tests, Religion, and Drinking Water

Sir—Recently the Engineers' Society of Western Pennsylvania took a trip to Detroit and viewed some engineering work in that city. We were entertained by the Engineers' Society of Detroit, and the entertainment was all that could be desired. We had luncheon in one of the largest office buildings in the world and inspected the largest filter plant in the world.

One of the most impressive things we saw was that apparently non-dividend-producing thing called housecleaning. It was evident in the plant where they squirt out the Fords, in the Detroit-Edison power plant, and in the water-works. Sweeping down the outside walls of a power plant, sweeping up the floors of a factory and a steel plant, painting with aluminum paint the bustle pipes of a blast furnace, to say nothing of burning coal economically and completely by using stokers outside, no doubt, of the smoke consuming zone: these things are worth while, but we could name localities where they do not mean anything, if we wanted to be disloyal.

It was only a few years ago that our leading doctors were telling us that it was useless to filter water, that a germ could squirm through any filter made, and that the only safe way is to boil the water 10 or 15 minutes.

Here is Detroit with a plant that is capable of converting 400,000,000 gal. of river or lake water into safe drinking water every day, and the proof of it is the great reduction in the death rate due to typhoid fever.

The church and its founder are often criticised because they have no social program, simply cleansing the fountain-head, the source of all evil and good, the individual heart, and these critics would, by mass psychology, correct the actions of men—boil the water at the faucet. This, of course, is religion, but even engineers can think and talk along religious lines if need be.

A thing that impressed me about the reinforced-concrete filter tanks is the fact that in large areas there is no provision for expansion and contraction other than the steel reinforcement. I asked about the method of waterproofing. No waterproofing—simply fluid concrete. Any leaks? No.

Investigators are making thousands of tests with the sole aim of discovering how to make concrete of the absolute maximum strength, and water content of the absolute minimum is all they can see. High compressive strength is of minor importance, and the attaining of it is very uncertain, because it requires extreme care and expert supervision.

Density and impermeability and ability of the concrete to flow readily around the reinforcing steel are of the utmost importance, and these can only be attained by the use of fluid concrete.

Men everywhere are ridiculing and condemning the slump test, and with reason. I should like to ask any advocate of the slump test, and the stiff concrete that the application of any slump test implies must be used, what slump test he would recommend for the enormous girders illustrated in your issue of July 5, 1923, p. 7, where the tremendous volume of steel in the balcony girder of a theater in Los Angeles allows room for not much more volume of concrete than that of the steel. This is massive concrete. The latest Joint Committee Report gives a slump test of 2 for this character of construction. Is there an engineer living who imagines that concrete of such consistency could be worked around this steel or that concrete remotely approaching this consistency would be appropriate here? EDWARD GODFREY.

Pittsburgh, Pa., Oct. 9, 1923.

In Defense of the Cement Companies

Sir—I have read with much interest the letter from O. T. Reece, county engineer, Neosho County, Kansas, which appeared in *Engineering News-Record*, Oct. 4, 1923, and in which he refers to certain methods of marketing cement.

The cement company with which I am connected has its plant in the Lehigh Valley. I have no knowledge of the marketing methods of the cement companies to which Mr. Reece refers, but inasmuch as his letter apparently assumes that the marketing methods to which he objects are those of all cement companies in the United States, let me call attention to the fact that in this section of the country the situation to which he refers has not arisen in our dealings with our customers.

As a matter of fact, we are selling cement direct to the state highway department of Connecticut and have signified to at least one other state governor our willingness to sell direct to that state. In one very recent case we offered to sell direct to the state highway department of Pennsylvania but in that state the purchases of cement are made direct by the contractors doing the work.

It is true that we have sold these contractors generally through dealers but we have found no objection on their part to this custom. Apparently the dealers in this section can, with a reasonable margin of profit, cover services which they perform for the contractor.

I have never heard of such sums as Mr. Reece mentions, "from 25 to 60c. per barrel," going to any local representative of our mill or any dealer handling our product. On the contrary, dealers in Pennsylvania through whom we have received contracts for state highway work have taken a profit of as low as one, two or three cents per barrel. In one case with which I am familiar, and in which they received as high as 10c. per barrel, we were unwilling ourselves to handle the account direct on account of a question in our own minds as to the credit rating of the contractor concern. Nor have I ever heard in this district of any such "margin" as Mr. Reece refers to "in one case 76 cents per barrel and in another 87 cents per barrel."

Of course, the principal reason for our selling the large percentage of our cement through dealers is that it is apparently the desire of our customers in this section to do business in that way.

Mr. Reece also refers to "association rules" in connection with the marketing methods to which he objects. The only association of cement companies that I know of is the Portland Cement Association which has nothing whatever to do with marketing methods or the price at which cement is sold. It is an organization devoted entirely to the promotion of the use of cement; to technical research; and to the assistance in the proper use of cement in highway and building construction. JOSEPH BROBSTON, Vice-president, Dexter Portland Cement Co.

Nazareth, Pa., Oct. 22, 1923.

Critical Tests for Earth Dams, With or Without Cores

Sir—The recent failures of earth dams and the variety of causes assigned bring us squarely to a consideration of the action that takes place when an earth embankment is subjected to its initial saturation, or to a renewed hydrostatic pressure after being allowed to dry out for a long period.

Observations taken during the initial test of 200 miles of canals and laterals, and more than twenty earth-fill dams, constructed during different seasons of the year, and involving various amounts of moisture and compacting, on dams up to 120 ft. in height, and on fills for embankments ranging up to 50 ft., have defined some critical periods which may or may not recur for the same structure.

A loose earth dyke on being first subjected to hydrostatic pressure will rapidly become saturated on the water face, and for varying depths within the mass, dependent upon the porosity and degree of compactness. As the surface of the reservoir rises, the plane of saturation progresses upward, coinciding with the hydraulic gradients for the given material at the various elevations. The portions will become saturated and subjected to settlement in the numerical order shown by Fig. 1. Resulting from the subsidence of any given section there is a tendency for caverns of arched tunnels to form, inviting a free flow of water

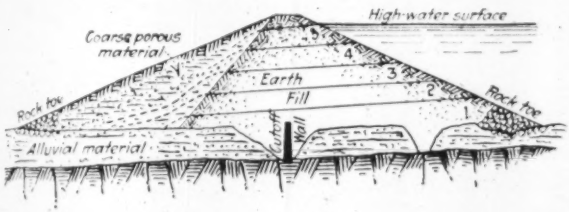


FIG. 1—SUCCESSIVE PLANES OF SATURATION

farther into the interior of the embankment, until the degree of saturation and weakening of the cohesion causes a caving of additional material from the roof section. A critical period arrives for the dyke every time one of the tunnels or caverns retains its roof intact for a considerable period, allowing free access of water flowing to the interior, and tending to form a blister or lens of liquid under pressure near the downstream face. If a well compacted stratum is encountered, such as would result from highway traffic across the fill during a lull in the construction, the roof of the cavern or tunnel may endure until an accumulation of water or a channel has been so thoroughly established as to cause the certain and rapid failure of the dam. However, the agitation of the body of water due to the falling masses from the roof, causing a sort of surge and water hammer action, usually insures the continuance of the caving process and thus prevents the formation of a long tunnel or a cavern of great dimensions.

All earth dams that function must undergo a similar test at least once, the saturation and subsidence and forming of vaulted caverns differing only in degree from the extreme case above described. The dry fills confining the sluiced materials of hydraulic-fill dams are subjected to the test during construction; and it is safe to assume that all recurring ones will be less severe. Dams provided with a complete cutoff and corewall (Fig. 2) or with durable and effective sheetpiling cutoff surmounted by the impervious diaphragm and adequately connected with the canyon walls, undergo saturation for only the upstream section. The downstream portion, constituting at least 60 per cent of the structure, is nearly constant in volume, and unless actually overtopped by floods it will remain indefinitely. The presence of the corewall prevents the movement of currents of water in the saturated upstream portion, and hence prevents the loss of the soluble elements.

Failure of Apishapa Dam, Colorado—From the various accounts of the construction, behavior, and failure of the Apishapa dam it appears evident that the initial saturation of the upper strata of this structure was attended by the formation of the tunnels and cavernous structures above described. No doubt this was accentuated by the loss of soluble materials. Mr. Mann's judgment concerning the probable settlement of 5 ft. after filling appears to be justified. If the roofs of the caverns and tunnels that caused the main leaks at Points A and B of the plan appearing in *Engineering News-Record*, Sept. 13, 1923, p. 419, could have been made to cave in and check the flow while the saturated material settled to its proper place to fill the sharp crevasses along the planes of cleavage, where the main fill evidently faulted due to its greater subsidence, it is quite probable that the structure would have remained intact. McMillan Dam on the Carlsbad Project, New Mexico ("United States Irrigation Works," by A. P. Davis), was saved under very similar conditions in 1914 by the prompt discovery of the well defined channel, and the temporary closure with sacks of earth.

The Avalon Dam, New Mexico—Prior to the adoption of the Carlsbad Project, New Mexico, by the U. S. Reclamation Service, the Avalon dam on the Pecos River had failed twice; the first time in 1893 by overtopping; the second time in 1904, probably from causes similar to those at the Apishapa dam and to the threatened failure of the McMillan dam above referred to. The U. S. Reclamation Service installed a combination of reinforced-concrete core-

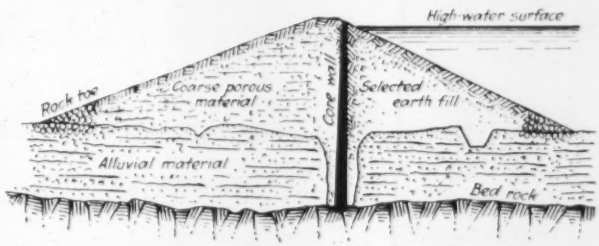


FIG. 2—CROSS-SECTION OF EARTH DAM WITH COREWALL

wall and steel sheetpiling surmounted by a riveted steel diaphragm.

Quoting from Mr. Davis's treatise, referred to above: "The provision of a corewall was an innovation upon the usual Western practice, and especially that of the Reclamation Service. Its necessity arises from the presence of a large percentage of soluble salts in the earth available for the embankment. In use, the slow percolation of water through such a bank gradually leaches out the soluble matter, leaving the bank more and more porous, and it soon becomes unreliable as a barrier against water. The corewall is thus made necessary, and also serves the purpose of preventing destruction through the ravages of burrowing animals."

Failure of the Schaeffer Reservoir Dam, Colorado—The great flood at Pueblo, Colo., June 3 to 6, 1921, was prolonged at a destructive stage by the failure of the Schaeffer reservoir dam suddenly on June 5. The freeboard from the floor of spillway to the crest of the dam was 10 ft., and failure occurred with only a 4.5-ft. depth on the spillway. To an observer who witnessed the failure, the water appeared to give a great surge that overtopped the central 75-ft. section, and the reservoir was empty in about half an hour. It will remain a question whether the water surged over the central portion as a great wave, or whether subsidence of the saturated maximum section reduced the crest below the water level. Another question for speculation is the effect that a complete corewall or diaphragm would have produced, at both the Schaeffer and the Apishapa dams. It is probable that 5 per cent of the cost of an earth dam will provide a complete diaphragm or corewall, especially where the cutoff walls are already installed and the core construction keeps pace with the earth fill.

Modern engineering practice, wherever earth dams are extensively used, has tacitly recognized that percolation will take place through such structures unless stopped by

such positive means as a corewall or a diaphragm. An eminent engineer who failed to accept this fact very naturally condemned a large dam then under construction because of the coarseness and lack of cohesion of the downstream section. He built another dam conforming to his idea that the downstream portion should be just as impervious and cohesive as the upstream face; this dam failed, probably due to inadequate drainage of the percolating water; while the dam condemned by his judgment on account of its coarse pervious downstream section is listed among the successful earth structures, in standard engineering works.

Dry earth embankments have been built during emergency conditions with a double-lap plank diaphragm; and when subjected to hydrostatic pressure which caused marked settlement and consolidation of the upstream section, the timber diaphragm functioned perfectly and retained its original alignment very closely.

The writer has been unable to discover a single case on record where an earth dam with complete corewall or

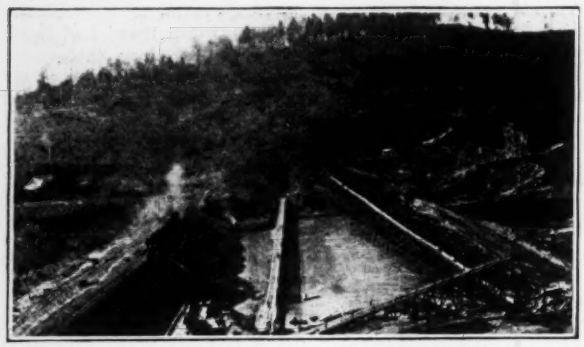


FIG. 3—HETCH HETCHY HYDRAULIC FILL DAM WITH COREWALL; UNDER CONSTRUCTION, OCT. 8, 1922

diaphragm has failed except through overtopping or a defective tunnel. It seems to be well established that the best insurance that can be provided against failure, either under the initial or the recurrent tests to which earth dams are subjected, is a complete cutoff and corewall or diaphragm from foundation to high-water level. The Hetch Hetchy Project for San Francisco's water supply includes a hydraulic-fill dam with corewall (Fig. 3) that represents the best practice for such construction.

Phoenix, Ariz., Sept. 27. C. S. JARVIS,
Civil Engineer.

Highway Accidents at Railway Crossings

Sir—The abatement of automobile accidents at railroad grade crossings is a problem which deserves very intensive and extensive study by the greatest possible number of people. There is much need, however, that those who concern themselves with this problem should keep their judgment well balanced. They should realize that only a small percentage of automobile accidents occur at grade crossings, that proposed methods for their elimination should be such as to appeal to people as reasonable and sensible and that before enactment any proposed law should be tested in actual practice by representative automobile drivers from different parts of the state and under varying conditions. There is much need for uniform state automobile laws.

Some railroad executives and others propose as one method of prevention that all automobiles shall come to a full stop at all railroad grade crossings. A method which better appeals to the reason is contained in an opinion rendered by Justice Charles C. Van Kirk, of the Appellate Division of the Supreme Court of the state of New York. In this opinion Justice Van Kirk said, "The safe limit to speed in approaching a crossing is that speed at which the driver of an automobile, as he arrives at a point where he can see an on-coming train, when it is near enough to render crossing ahead dangerous, can stop his car if necessary before he reaches the track. If he cannot see without stopping he must stop."

It may be advisable to delegate to state public service commissions or similar bodies the power to post at blind crossings, notices requiring automobile drivers to stop their automobiles before making such crossings, but if thirteen million drivers in the United States should be required to come to a full stop every time that they make a crossing where an extended view of the track is available the greatest possible impetus would be given to the plan of separating at once all grade crossings.

More care should be exercised by state highway departments to eliminate grade crossings when practicable during the reconstruction of state highways. In one state two grade crossings at which there have been several deaths and two or three automobiles demolished could have been eliminated at a cost of but little more than the amount expended in improving the road connecting those crossings. A device which would save many lives would be to paint on the sign at a crossing the number of tracks at the crossing. People frequently see one train pass the crossing and, thinking it to be a single track and that there will be no more trains, run onto the crossing only to be struck by a train on another track.

It might be desirable also to empower a state public service commission after studying the conditions at a dangerous crossing to require the train to stop before proceeding over the crossing or to slow down so that it can stop to avert an accident providing that there are but few trains per day on the railroad at that point while there are many crossings per day by automobiles.

The whole endeavor should be to secure as much safety to the careful driver as practicable without enacting laws which needlessly impose burdensome restrictions upon him. The careless driver is hard to reach. In one state the law requiring all automobiles to come to a full stop before crossing a grade crossing seems to be about as effective as the non-tipping law. The constant effort should be to separate grade crossings as fast as is expedient.

More care should be exercised in the character of signs erected. On one state trunk line where the highway parallels the railroad and passes under the tracks by a right angle turn a large sign with circles like a target is erected with "STOP" painted in huge type. No one stops, it is not expected by those who erected the sign that anyone will stop. Thus the force of signs is weakened and the impression is created that the message on the sign need not be obeyed. CHARLES A. HOLDEN,
Director, Thayer School of Civil Engineering.

Hanover, N. H.,
Sept. 20, 1923.

Elimination of Plants from Reservoirs

Sir—In the course of my weekly perusal of your journal I have noted a reference to the trouble of one of your Colorado correspondents caused by water lilies (*Engineering News-Record*, Sept. 27, 1923, p. 509), and I venture to offer the results of my observations on this subject in the Far East, as they might possibly indicate another way out of the difficulty. In central China, where there are vast areas of waterlogged land, the natives collect the roots of the water lilies and dry them out to make a kind of flour, as you suggest. This food is appreciated only by the poorest of the inhabitants, so it is, apparently, of no great value. It is, however, quite noteworthy that the collection only goes on in water where the men reaping the harvest can stand on the bottom with the water just up to their arm-pits—say less than 5 ft. The men feel about for the roots with their feet and when they are discovered tear them up, to be taken away by the attendant sampan (native boat). Now it is noticeable that the lilies grow abundantly in water of the depth just mentioned; in other depths they do not flourish.

Might it not be possible, after allowing for climatic variations between Colorado and Hunan, to overcome your correspondent's trouble by either increasing or reducing the depth of water in which the lilies are growing?

London, England, Oct. 16, 1923. "PHILLIP"

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Highway Research Board to Hold Annual Meeting

National Research Council Body Will Meet in Washington November 8 and 9

The third annual meeting of the Advisory Board on Highway Research of the National Research Council is to be held at the headquarters of the Council in Washington, D. C., Nov. 8 and 9. The status of reasearch in the various fields of highway engineering and transport will be evaluated as the basis for further research in this element of highway transportation.

Besides routine matters which include approval of interim actions of the executive committee, appointment of committee on nomination of officers, and the report of the director, there will be reports of various committees as follows:

Report of Committee No. 1, on economic theory of highway improvement, chairman, T. R. Agg, Iowa State College.

Report of Committee No. 2, on structural design of roads, chairman, A. T. Goldbeck, U. S. Bureau of Public Roads.

Report of Committee No. 3, on character and use of road materials, chairman, H. S. Mattimore, Pennsylvania State Highway Department.

The above reports will be made on the morning of the first day's session and in the afternoon an inspection tour will be made of the new building of the National Research Council and the experimental farm of the Bureau of Public Roads at Arlington, Va. The evening session of Nov. 8 will include an address by Thomas H. MacDonald, chief, Bureau of Public Roads; a report upon highway research work of the American Association of Land Grant Colleges, by Dean Anson Marston, of Iowa State College; a report of Committee No. 6 on highway finance, of which Dr. J. G. McKay, U. S. Bureau of Public Roads, is chairman; and an explanation of the research program of the North Carolina State Highway Commission by Charles M. Upham, its chief engineer.

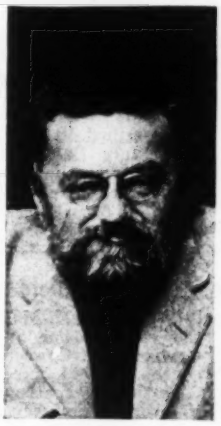
During the third session, to be held the morning of Nov. 9, a report of Committee No. 4, on highway traffic analysis, of which George E. Hamlin, of the Connecticut Highway Commission, is chairman, will be made. Committee No. 7, on maintenance, chairman, W. H. Root, will also report.

Aldred Lectures at M.I.T.

Massachusetts Institute of Technology has announced that the first of the twelve lectures under the course of lectures established by J. E. Aldred will be held on the afternoon of Nov. 9. Gerard Swope, president of the General Electric Co., will deliver this first lecture. A number of prominent men representing all branches of industry will address the following meetings, which are scheduled to cover the next five years.

Charles P. Steinmetz Dies

Dr. Charles P. Steinmetz, consulting engineer for the General Electric Co. and world famous electrophysicist and inventor, died suddenly at his home in Schenectady, N. Y., Oct. 26. He had returned but a week or two before his death from a tour of the Pacific Coast, and the exhaustion incident to the trip is presumed to have been indirectly responsible for his death.



Dr. Steinmetz came to the United States from Germany in 1889 at the age of 24, having been born in Breslau. He had received a thorough scientific training in his native city, in Berlin and in Zurich, Switzerland. His first employment in this country was with the Osterheld & Eichemeyer Manufacturing Co., Yonkers, N. Y., first as draftsman, then as electrical engineer and designer, and finally on research work in charge of the laboratory. With the absorption of the Eichemeyer interests by the General Electric Co. Dr. Steinmetz joined the latter organization, and for virtually the entire 30 years he was with that company, he was its chief consulting engineer.

Early in his career in America Dr. Steinmetz was made professor of electrical engineering at Union College. Later his title was changed to professor of electrophysics, and this chair he held until his death. He was granted an honorary Master of Arts degree by Harvard in 1902 and an honorary Doctor of Philosophy degree by Union the next year. He was a past president of both the American Institute of Electrical Engineers and of the Illuminating Engineering Society.

Dr. Steinmetz' 200-odd inventions were concerned largely with the transmission of power and the design of alternating current motors, though they also covered the magnetite-arc and other lamps, elevator motor appliances and electrically-propelled vehicles.

Coffin Medal Awarded

The Charles A. Coffin Gold Medal, created by the General Electric Co. for the best contribution to electric transportation, was awarded to the Chicago, North Shore & Milwaukee R.R. Co. at Atlantic City Oct. 11 at the annual convention of the American Electric Railway Association, the award being made on the basis of success in "giving service and telling the public its story."

Engineers See Coolidge on Federal Reorganization

Am. Soc. C. E. Committee Pleads for Unification of Non-Military Engineering Services

Washington Correspondence

President Coolidge evidenced great interest in securing the viewpoint of civil engineers concerning the question of government reorganization, particularly that having to do with public works, when Charles F. Loweth, president of the American Society of Civil Engineers, together with a special committee from that society, waited upon him Oct. 30 to present and explain a resolution adopted by the Board of Direction of the society. The President asked numerous questions and apparently was impressed by statements of the members of the committee that the creation of a Department of Public Works alone constitutes a plan of the greatest value in making possible numerous efficiencies in the conduct of the engineering and technical services of the federal government.

The President was assured of the civil engineers' interest as citizens in the general plan of reorganization. They pointed out, however, that members of their profession probably are qualified to advise most intelligently concerning that portion of the plan which affects reorganization of the Department of the Interior. The President expressed his appreciation of the tender by the engineers of any assistance, either to him or to his assistants, they could render in the development of the plan.

Letter Given Coolidge

The letter which the special committee handed to President Coolidge follows:

"As members of a committee appointed by the Board of Direction of the American Society of Civil Engineers, we come to present to you resolutions adopted by said Board endorsing and commending the recommendations of President Harding and his cabinet for the reorganization of the executive departments of the government, and more particularly those having to do with public works.

"For many years the engineers of this country have been keenly interested in the activities of the government in the field of public works. As a result of conditions developed during the war period an intensive study of governmental methods of administering public works was made by them.

"This and other efforts culminated in S. B. 2232 to create a Department of Public Works and define its powers and duties; and in bills before the House, H. J. Res. 339 and 390, to create a Joint Committee on the Reorganization of the Administrative Branch of the Government.

"Later, the engineers of the country were gratified by the recommendations of the President which were based upon

a careful study by the Joint Committee on the Reorganization of Government Departments authorized by the last-mentioned bill.

"The American Society of Civil Engineers is the oldest of the national engineering societies in this country. It has a membership of 11,000 from all parts of the country. Many of its members are thoroughly experienced in the administration of public works and affairs.

"This society bespeaks your active interest in this measure, particularly with respect to the provisions relating to the administration of public works, to the end that it may become law. The resolutions passed by its Board of Direction are attached hereto.

"The Board will be happy to be of service to you in this connection.

"Yours respectfully
"C. P. LOWETH, President
and Chairman of Committee, Chicago
"WILLARD T. CHEVALIER
New York City
"A. H. MARKWART
San Francisco, Calif.
"LEONARD METCALF
Boston, Mass.
"CHARLES H. PAUL
Dayton, Ohio."

The resolution passed by the Board of Direction reads:

"RESOLVED: That the Board of Direction of the American Society of Civil Engineers endorses and commends the recommendations of the President of the United States and his cabinet, that the military and non-military engineering activities of the government be separated and that the design, construction and maintenance of non-military public works be assembled as far as practicable in one department, under one head, and that only those activities closely related thereto be included in that department. We also commend the effort to apply similar principles to all the departments, and to allocate the numerous independent offices to appropriate departments so far as possible. We believe such action will tend to eliminate duplication, to co-ordinate public activities, and in many ways to promote economy and efficiency in the public service.

"RESOLVED, That the president of this society be empowered to appoint a committee of five members of this society of which he shall be chairman, to present the above resolution to the President of the United States, and to appropriate officials of Congress, and of the executive departments, and to take such other action as it deems wise in furtherance of the principles above endorsed."

Highway Conference to Be Held at Michigan University

The tenth annual Michigan conference on highway engineering will be held Feb. 11-14 at Ann Arbor. The list of speakers will include engineers from the Michigan State Highway Department, county commissioners and engineers, municipal engineers, members of the faculty and prominent highway engineers from other states. The conference will be open to all highway commissioners, engineers, contractors and others interested in highway improvement. No fees will be charged by the University. The program will be issued in January, 1924.

Pueblo Soon to Receive Bids on Flood-Protection Work

Plans for flood-protection work in Pueblo, Colo., have progressed to such an extent that bids will be received within the next two months, according to advices from the Dayton Morgan Engineering Co., in charge of engineering. Work will involve the construction of a new channel for the Arkansas River through the city which shall carry 125,000 sec.-ft. of water; and building 34 miles of railroad track and a barrier dam 35 ft. high and 3,060 ft. long. The plan has been officially approved and benefits appraised upon which assessments will be levied. The total estimated cost of the project, including land and administration, is $4,000,000. The project was described in *Engineering News-Record* July 12, p. 48. Formal approval was given the plan by District Judge Park early in August. (*Engineering News-Record* Aug. 16, p. 280.)

New Bridge for Springfield

The city council of Springfield, Mass., has authorized the construction of a permanent bridge across the Connecticut River at a cost not to exceed $1,000,000, to replace the one destroyed by fire in September (*Engineering News-Record* Sept. 13, p. 449, Sept. 20 p. 488). The bridge is to be built jointly by the city of Springfield and the town of West Springfield, the first-named paying nine-tenths of the cost and the last-named one-tenth. Dr. J. A. L. Waddell, New York, has been chosen by the joint committee to prepare plans for a bridge, in which work he will not be restricted to any particular type and will submit plans for both steel and concrete structures. There has been no hard and fast decision as to cost, this being governed in a large degree by the material decided upon. On financial grounds a steel bridge is favored, but on the other hand there is considerable sentiment in favor of a structure that promises to be most durable, even though it shall cost more. Speed in the completion is also regarded as an important consideration. A tentative plan has been presented for a nine-span steel open-deck bridge, 1,126 ft. long and 66 ft. wide.

Los Angeles Considers Colorado River Water Supply

Acting under instructions from the Board of Public Service Commissioners William Mulholland, chief engineer of the Los Angeles Bureau of Water Works and Supply, has put surveying parties in the field to determine the feasibility of bringing water from the Colorado River to supplement the city's existing water supply. Mr. Mulholland, who suggested the possibility of a Colorado River source after a recent inspection trip, stated in reply to an inquiry from a member of the *Engineering News-Record* staff: "At the present per capita rate of consumption the city's water supply from Owens River sources is sufficient for 2,000,000 people but an influx of manufacturing enterprises may change that rate." The city has not yet obtained a government grant to divert Colorado River water.

Reclamation Conference for New Orleans

Forestry and Home-Making Topics Also Scheduled for Meeting Nov. 19-22

A conference on forestry, reclamation, and home making is to be held at the Hotel Grunewald, New Orleans, Nov. 19-22, under the auspices of the Southern Pine Association, the Florida Development Board, the Mississippi Development Board, and the New Orleans Association of Commerce. An exceptionally interesting program has been prepared with the discussion headed by the following principal topics:

Use of waste lands for creation as needed of opportunities for rural homes; best means for utilizing denuded and cut-over lands through reforestation, grazing and agriculture; a national and state policy for handling and taxing such lands; forestry problems—a systematic plan for better use of the forest resources of the country and for insuring a permanent and adequate timber supply for the nation; subsidizing settlers on reclaimed lands—need of aid furnished by national and state agencies to encourage permanent and prosperous settlement; revision of existing reclamation law to make it nationally applicable, instead of sectionally as at present, thus more effectively meeting the needs of the country in creating opportunities for homes; settlement methods—successful ways of securing and safeguarding desirable settlers who may utilize the lands now idle; grazing and development of the animal industry; selective immigration; and financing the rural home-maker.

RESOLUTIONS TO BE OFFERED

A series of resolutions has been prepared for discussion and possible adoption. Among the most interesting of these is the following:

"Resolved, that we request the Congress of the United States to consider the recasting of the entire reclamation law, making it applicable to all parts of the United States, eliminating conditions which make speculation easy and which have encouraged tenantry and promoted soil deterioration, at the same time extending the good features of the law so as to be applicable to the reclamation and best use of lands in whatever part of the country they may exist. Such development to take place at the time and in the manner to best promote the creation of opportunity for self-supporting farm homes. Also, that the organization of a reclamation service be provided for by law and be placed on a permanent basis. The reclamation act should be recast to provide a well considered bureau of service under a director or other officer selected for experience and ability, appointed by the President with the advice and consent of the Senate, and removable only for cause."

The executive committee has for its chairman C. S. Ucker, of Baltimore, Md. The headquarters of the conference are at 616 Real Estate Bank Building, New Orleans, La., or 904 International Building, Washington, D. C. The exact title is the Forestry, Reclamation, and Home-Making Conference.

Founder Societies Move Toward Co-operation

Joint Committee Agrees on Conference Committee Consisting of Presidents and Secretaries

A move toward more active co-operation of the four national engineering societies was made on Oct. 29 when a joint committee of the societies adopted a report recommending the formation of a Joint Conference of the four Founder Societies with a membership consisting of the presidents and secretaries of the societies. The report will be submitted to the governing bodies of the societies as soon as possible and when accepted by each will be put into force. It was adopted Oct. 29 by the Council of the Mechanical Engineers.

In anticipation that this report will be adopted by the other three Founder societies a meeting of the Joint Conference Committee has been called for Dec. 10 at the Engineering Societies Building, New York, to consider any business that may be brought before it and particularly to consider the possible enlargement of the activities of Engineering Foundation.

The report reads as follows:

"At the meeting April 16, 1923, of the Board of Direction of the American Society of Civil Engineers the appointment of a committee of five, the chairman to be the President, was authorized 'to confer with the officials of other national engineering societies with a view to formulating some permanent, workable method of joint co-operation on public matters and report its recommendations to the Board.' Invitations to appoint members of such a joint committee on co-operation were promptly accepted by the three other Founder Societies. At the first meeting of the joint committee July 24, 1923, a thorough discussion of co-operation was participated in by all sixteen members present. As a result a subcommittee, consisting of the presidents and the secretaries of the four Founder Societies, was authorized to report at the next meeting of the joint committee on two matters, as follows:

"1. The possible fields and means of joint co-operation of the four Founder Societies.

"2. Possible modifications in the Federated American Engineering Societies.

MEANS OF CO-OPERATION

"With reference to the first matter, your committee has given careful consideration to the possible fields and means of joint co-operation of the four Founder Societies. There are many activities on which the four Founder Societies have been co-operating for many years, and in regard to which they should continue to confer in order to exchange information, determine policies, and secure concert of effort in the execution of these policies. The following lists of such activities are submitted as representative only, and are not intended to be inclusive or exhaustive. It is recognized that the activities listed fall into two general classes; first, those which concern both the four Founder Societies and the whole engineering profession; and second, those which concern only the four Founder Societies. In the arrangement of the lists, no importance whatever should be attached to the order in which the activities are given.

Activities Which Concern Both the Four Founder Societies and the Whole Engineering Profession

1. Engineering education.
2. Professional ethics.
3. National and state legislation of interest both to the public and to the engineering profession.
4. Registration of engineers.
5. Co-operation with other organizations.
6. Preservation of efficiency in public offices requiring engineering knowledge, as exemplified by the office of Director of the United States Reclamation Service.
7. Local Sections. While at first thought it may appear that local sections are the concern of only the four Founder Societies, yet it should be remembered that the American Society of Automotive Engineers and several other societies have their local sections, and that furthermore, the activities of these local sections are closely related to the activities of many local and regional engineering clubs.
8. The Engineering Employment Service. While this service is at present restricted to the members of the four Founder Societies, it is anticipated that there is some possibility of the scope of the service being widened in the future.
9. Research.
10. Standardization.
11. Publicity.
12. Engineering abstracts and indexes.
13. International engineering congresses.
14. International relations.
    (a) Foreign relations.
    (b) The exchange of courtesies as in the case of exchange professors to the United States from foreign countries.
    (c) The Kelvin Medal.
    (d) Pan-American relations, such as those in the field of standardization.

Activities Which Concern Only the Four Founder Societies

15. Administration of the joint property by the United Engineering Society.
16. The Engineering Societies Library.
17. Engineering Foundation.
18. Joint professional meetings.
19. Arrangement of the yearly schedule of time and place for regional meetings and conventions.
20. The award of the John Fritz Medal.
21. Student branches.
22. The technical and professional divisions and committees of the four Founder Societies.
23. Joint committees, including both the technical committees and the non-technical committees, such as the Joint Finance Committee.

"In view of these and similar inter-society activities it is recommended that the policy of co-operation followed for many years past by the four Founder Societies be fostered in the future. As to the machinery necessary to bring about the proper co-ordination of effort of two or more of the societies, it is believed that at the outset a Joint Conference Committee consisting of the four presidents and the four secretaries would be an effective means of giving preliminary consideration to the various problems, of suggesting the policy to be followed in each case and of recommending the procedure for carrying out these policies, using as far as practicable existing agencies. The first chairman of the committee, for a term of one year, should be the president of the American Society of Civil Engineers, and thereafter the president of each of the four Founder Societies in order of seniority. Whenever a president or a secretary cannot attend a meeting of the committee he should appoint an alternate.

"In regard to the second matter upon which the subcommittee was asked to report, namely, possible modifications of the Federated American Engineering Societies, your subcommittee feels, since the representatives of some of the societies who are not, or may not be, members of the Federation might not wish to be placed in the position of recommending changes, that consideration of this phase of the problem should be postponed, particularly as a committee of the Federated American Engineering Societies is now considering this very thing.

Respectfully submitted,

AMERICAN SOCIETY OF CIVIL ENGINEERS
Charles F. Loweth, President
John H. Dunlap, Secretary

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
E. P. Mathewson, President
F. F. Sharpless, Secretary.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS
John Lyle Harrington, President
Calvin W. Rice, Secretary

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
Dr. F. B. Jewett representing President Harris J. Ryan
Calvert Townley representing Secretary F. L. Hutchinson

SUBCOMMITTEE OF THE JOINT COMMITTEE ON CO-OPERATION"

Philadelphia Engineers Hear Talk on Japanese Earthquake

Interesting sidelights on the Japanese earthquake were presented before the Engineers' Club of Philadelphia on Oct. 23, by Dr. Judson Daland, who recently arrived home from Japan. Dr. Daland was in Tokyo on Sept. 1 when the earthquake occurred going from Tokyo to Kobe afterward.

Recovery from the earthquake, according to Dr. Daland, has been hampered by three things: first, a general hysteria that seized the people, and that roused up race hatred with the Koreans; second, a dazed condition of people in which they seemed unable to start about reconstruction work; and third, the action of the Japanese government in refusing to give information about the disaster.

In Tokyo, Dr. Daland said that no production had been started as long as six or seven days after the earthquake. The Japanese government has been persistent, he asserted, in withholding information about the extent of the disaster.

What's Ahead in Business, as Judge Gary Sees It

Extracts From Address of Steel Head at Iron and Steel Institute Meeting in New York

"It is doubtful if our government can at present be of much assistance in attempts to restore the equilibrium of Europe. Voluntary advice or sympathy just now would not be acceptable. Practically, we can be of benefit only by example.

"It would not be appropriate for us to take sides in European controversies nor to condemn individual attitudes or conduct; but we know the great seas are not wide enough to separate us from the influences of disaster in Europe. We are affected in our finances, our commerce, our industries, our civic, political and social life and our morals. Citizens of Europe are embarking for the United States whenever possible; not always the most worthy are included, which is a pity. Their ideas permeate our social and business life. The whole structure of civilization has been shaken.

AN INDEPENDENT NATION

"If the European atmosphere and conditions dominated our affairs, our business men might be depressed and somewhat doubtful of the future; but fortunately they do not. We are, or at least we may be, independent of all other countries so far as business progress and prosperity are concerned. If we properly conserve and utilize our natural resources and legitimately manage our private and public affairs, availing ourselves of the opportunities that are presented, we may and will continuously and adequately prosper.

"There will be temporary interruptions, recessions, and there will be fluctuations, but the man of business courage, with a reasonably clear vision of the long future, pays little attention to temporary hesitation in business progress. He knows that the current of prosperity in the United States is so strong that even though it may be occasionally modified by unnatural or unreasonable obstructions, this will result in accumulation of volume and force which will soon be overwhelming and stronger than ever before.

"What is the disposition of the President concerning the affairs of the country? This is shown by a statement recently made by one occupying a prominent official position as follows: 'It is very evidently the aim and effort of the administration to encourage in every way policies in both business and politics which will tend to the elimination of agitation. The very evident desire in all governmental quarters is to extend the fullest assistance to the constructive forces of the country. The removal of elements of uncertainty and of misgivings, and the stabilization of business conditions, are a constant aim, and the feeling among those most familiar with the reflections of the business situation is that substantial progress is being made along these lines.'

"It is also important to know the opinion of the Administration concerning the present trend of business. This likewise was referred to by the same authority already mentioned, as follows: 'The impression in Washington seems to be that industry throughout the country is proceeding on a commendably conservative basis, with avoidance, so far as possible, of unnecessary advances in prices, or avoidable expansions which would engender keen competition for labor. With a continuance of this general attitude, it is felt that business should continue generally good for the remainder of this year. While there is reticence about making prophecies for the future, the general opinion seems to be that if this attitude continues there can be reasonable assurance of a projection of generally satisfactory business conditions at least well into next year.' It is believed these statements represent the mind of President Coolidge.

Deeper Hudson Advocated

Special Correspondence

During the past three weeks there has been a revival of the boom for a deeper Hudson staged principally through the Albany newspapers.

This revival is said to emanate from those who want the Hudson dredged to a 27-ft. channel to Albany and eventually the Barge Canal deepened into a ship canal as an offset to Canadian projects.

The cities in the Capitol district have gone so far as to get together and form a committee; also to engage the Technical Advisory Corp., of New York City, to collate data regarding shipments of freight through Albany which is to be presented to the War Department and later to Congress with a request for an appropriation.

The dream of Albany is to become a seaport and bills will probably be introduced in the next legislature providing for a state appropriation for terminals and a law providing for a Greater Albany Port Authority.

There are those in Albany who cannot take the project seriously. They say that after the expenditure of forty or fifty millions boats 700 ft. long will come up to Albany direct from Liverpool and readily turn around in a 250-ft. channel. In the winter time the Hudson River will be heated with electricity generated in the St. Lawrence River so as to keep navigation open. Albany will become a seaport town with a population of 5,000,000; water front saloons with 5-cent whiskey and 3-cent beer will be established and New York City will be just a port of call. When help is scarce it will not be infrequent to see ocean going steamers go up onto Capitol Hill and shanghai a crew out of politicians.

Ohio Highways and Public Works Personnel Announced

L. A. Boulay, the new Ohio Director of Highways and Public Works, announces appointments, for the eleven divisions, of division engineers and assistant engineers, respectfully, as follows: Division 1, F. A. Daum and R. W. Fry; Division 2, M. I. Henahan and F. R. Bell; Division 3, T. S. Brindle and E. R. Graham; Division 4, F. E. Swineford and Q. A. Campbell; Division 5, W. G. Smith and C. B. Shaw; Division 6, R. S. Beightler and F. C. Higley; Division 7, H. C. Miller and G. D. Scheuneman; Division 8, H. A. Nunlist and H. W. Walsh; Division 9, J. W. Graham and R. Z. Myers; Division 10, G. E. Carr and O. W. Merrell; Division 11, W. C. Fawcett and H. R. McCoy.

Random Lines

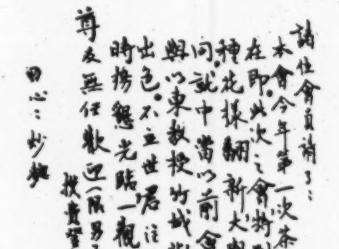
On a Certain Condescension

He wore rather conspicuously the blue shield of the American Society of Civil Engineers and dangling from his watch chain was the gold badge of Tau Beta Pi. Quite obviously he had been trained and had worked as a civil engineer. But when some simple engineering question came up he smiled a deprecating smile and said, more proudly than otherwise, "Oh! I don't know anything about that. You know I'm in the selling end; I don't keep up on these engineering details." It wasn't the words that riled us; it was the condescending manner, the obvious superiority of one who had finally gotten out of the rut onto the broad highway of success. And we went away wondering how much of the engineer's complaint about his "status" was due to this all too common attitude of mind of the engineer himself. The world takes us at our own estimation—to a large extent, at least. If the engineer, taking him by and large, thinks he is rising in the world when he commences to sell things it will be a long time before the world stops paying him—and other salesmen—more money for selling things than for planning them and making them.

* * *

Providence Engineering Society

44 Washington Street



LITERALLY TRANSLATED

Friday Evening, November 2, 1923, at 8:00

at the Society Rooms

- BE EARLY -

* * *

"It is not fair, we remind clients, to write on small sheets of paper; use regular copy-paper size, for communications of any longitude; this often saves us much **adhesive engineering.**"—Christopher Morley in the New York *Evening Post.*

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, Jan. 10-11, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16, 17.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-23, 1924.

The Engineers' Club of Cincinnati had for its joint meeting with the Cincinnati chapter of the American Institute of Architects, on Oct. 18, a paper on "New Aspects of the Housing Problem" by Blecker Marquette, executive secretary of the Cincinnati Better Housing League.

The Illinois Municipal League will hold its annual meeting at Urbana, Ill., Nov. 1 to 3. The subjects of papers and addresses include the following: (1) Uniform traffic regulations; (2) inspection and purchasing methods for municipalities; (3) street resurfacing methods in Illinois; (4) publicity methods by which officials can keep citizens informed as to municipal activities; (5) city planning and zoning; (6) superhydro-electric power and its relation to municipal development. Prof. R. M. Story has resigned as secretary but continues as treasurer. The executive board, therefore, has appointed A. D. McLarty as full-time secretary in view of the growing activities of the league. His office is at Urbana, Ill.

Personal Notes

BARRY DIBBLE, project manager, U. S. Reclamation Service, in charge of the Minidoka Project and the American Falls, Idaho, development, has been transferred to the Denver office of the U. S. Reclamation Service to take charge of electrical and mechanical work, succeeding J. M. GAYLORD, electrical engineer, who has resigned.

FRANK A. BANKS, construction engineer, Minidoka Project, U. S. Reclamation Service, has been placed in full charge of the American Falls, Idaho, development hitherto handled by Barry Dibble; and DANA TEMPLIN, engineer on the Minidoka Project, has been made acting project manager.

ARTHUR T. LUCE, superintendent of the water plant, Des Moines, Iowa, has resigned to accept the management of the municipal water plant at Marshalltown, Iowa, Mr. Hazelwood, Mr. Luce's former assistant, is acting superintendent of the Des Moines plant.

M. F. DE WITT, who has been assistant city engineer of Tucson, Ariz., for the past three years, has resigned to become construction engineer and superintendent for Kelsey and Robinson who have a $250,000 contract with the Mexican government for paving and a sewer and water system for Hermosillo, capital of the state of Sonora, Mexico.

FRANK H. KINSEY, formerly structural engineer in the construction department of the Bethlehem Steel Co., at Bethlehem, Pa., and chief engineer of the Edwin Burhorn Co., New York City, has opened an office as consulting structural engineer at 122 Bigelow Street, Newark, N. J.

CHARLES P. TOLMAN, after sixteen years as chief engineer and chairman of the manufacturing committee of the National Lead Co., has resigned and has opened an office at 111 Broadway, New York City, for consulting practice in manufacturing methods, handling materials and products, and dust and fume control.

WALTER G. KIRKPATRICK, of Atlanta, Ga., has accepted the professorship in municipal engineering at the University of Mississippi, succeeding Prof. Donald E. McLeod, who goes into enginering practice in North Carolina.

DAVID R. COOPER has resigned from the Fargo Engineering Co., Jackson, Mich., and has opened an office in the Dillaye Bldg., Syracuse, N. Y., for practice in hydraulic engineering, especially in the design of hydro-electric power plants.

PERCY A. CUPPER, state engineer of Oregon from 1918 to 1923 and attorney-at-law and consulting engineer, and ROBERT J. SIMPSON, assistant state engineer for the same period, announce the opening of a law and engineering office in the Oregon Bldg., Salem, Ore., and will specialize in water rights and cases involving operation and management of irrigation and drainage districts, water power, municipal works, and in general consulting engineering.

GEORGE LE BOUTILLIER, vice-president of the Long Island Railroad Co., has been elected president of the company to succeed the late Ralph Peters. Mr. Le Boutillier was born in 1876, graduated from the University of Cincinnati and in 1895 entered the service of the Pennsylvania R.R. in its engineering department. He remained in the engineering department, first as an assistant division engineer and then as a division engineer, until 1914, when he was transferred to the operating department as a superintendent. In 1920 he was promoted to be general superintendent at Harrisburg, Pa., and early this year he was elected vice-president of the Long Island R.R. to relieve Mr. Peters of the active management of the property.

IRA T. HOOK announces the opening of an office at 494 Norton St., New Haven, Conn., for industrial engineering service relative to materials and equipment, specifications, investigations, lay-outs, valuations and estimates. Mr. Hook is a gradute of the University of Michigan, was formerly on the engineering staff of the General Motors Corp., and recently was assistant professor of strength of materials in Yale University.

W. H. ROGERS, JR., Greenville, N. C., has been appointed county engineer of Pitt County, North Carolina, succeeding J. B. Harding who died Oct. 3.

JAMES F. MUIR, formerly supervising mechanical engineer with Toltz, King & Day, Inc., of St. Paul, Minn., and prior to that superintendent of mechanical equipment for the Minnesota & Ontario Paper Co. at International Falls, Minn., is now engineer in the mechanical division in the Boston office of Stone & Webster, Inc.

R. D. CORRIVEAU, engineer, who has been with the Canadian Deparment of Public Works since 1898, has been appointed assistant chief engineer of the department, succeeding Kenneth M. Cameron, chief engineer.

A. J. MCCUNE, state engineer for Colorado from 1899 until 1903, and from 1917 until now, has resigned and retired from active work. His successor has not been named.

Obituary

VICTOR H. REINEKING, consulting hydraulic engineer, Portland, Ore., died Oct. 16 in Milwaukee, at the age of 38. Mr. Reineking graduated from the University of Wisconsin in 1908. He was resident engineer on the Kilbourn, Wis., project, the High Falls and Johnson Falls dams on the Peshtigo River and a municipal lighting plant at Decatur, Ill. In 1913 he entered private practice in Portland and in conjunction with L. F. Harza reported on the Celilo Falls project on the Columbia River for the State of Oregon. Other hydraulic and hydro-electric work was reconstruction of the Elwha River dam and power plant at Port Angeles, Wash., and the Ochoco hydraulic fill dam. For several years he was assistant engineer to Baar & Cunningham, consulting engineers, Portland.

W. H. O. MURRAY, railway contractor of Montreal, was accidentally killed at Fabre, Que., recently. Mr. Murray was engaged upon an extension for the Canadian Pacific Ry. in the Temiskaming District. He served overseas four years with the Canadian Railway Construction Corps as major.

HOLMES BLAIR, president of the engineering firm of Blair & Drane, Charlotte, N. C., died Oct. 25 at the Charlotte sanitarium after a long illness; he was 63 years old. Mr. Blair's early years were spent in railroad construction in Illinois, Montana, the Dakotas and Colorado.

J. B. HARDING, for the last four years county engineer of Pitt county, North Carolina, died suddenly Oct. 13, 1923, from a stroke of apoplexy at the loading plant of his paving project. He formerly served seven years as locating and reconnaissance engineer for the National Railway Lines of Mexico, and was also chief engineer for the Atlantic Coast Realty Co. of Petersburg, Va.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Interviews with Industrial Executives—1

Rock Drill Users Profit by Manufacturers' Policy of Field Service

Obligation of Maker Held To Continue After Sale of Machine—Corps of Skilled Advisers Visits Jobs To Improve Operation and Care of Equipment.

WHAT is the manufacturer's responsibility to the purchaser of his equipment? Do his obligations end with the delivery of the product in good condition to the prospective user? Does the operation of the machine on the job concern him, or is the user the man upon whose shoulders the entire onus of operation and maintenance should rest? If not, what division of responsibility or what plan of co-operative service is possible and how can it be carried out in actual practice?

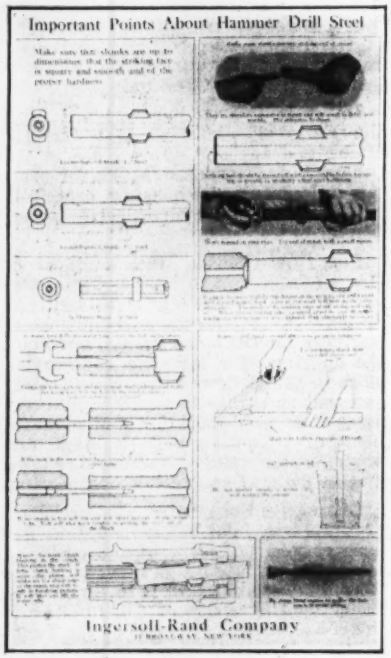
These are some of the questions to which equipment manufacturers have devoted a good deal of thought. No reputable maker would think of shipping to a customer a machine which was improperly designed, faulty in the character of its materials, or clearly unsuited to the work which it would be called upon to perform. Of course, scattered sales could occasionally be made by resorting to such practices, but the manufacturer seeking to establish or maintain his business on a stable, continuing, and expanding basis realizes that one of his biggest assets is the satisfied customer. In other words, the machine must not merely be right when it arrives on the job, but it must stay right, performing, day in and day out, its allotted task.

For Efficient Performance

The principle just enunciated is, in effect, the backbone of a policy of field service which the Ingersoll-Rand Co., manufacturer of rock drills and pneumatic machinery, has put into effect for the benefit of users of its equipment. It is realized that the successful and efficient performance of any piece of construction equipment must, in the last analysis, depend upon how it is treated by the man who runs it. In the case of rock drills, for example, the operator must be taught something of the structural limitations of his machine and be made to understand that he cannot ignore certain rules and then expect the tool to do its best.

Recognizing great possibilities, both for the maker and the user of equipment, in an educational service which would insure proper operation and maintenance on the job, the company has built up a corps of mine and tunnel equipment specialists who devote their entire time to visiting one job after another, inspecting machines and methods as actually employed on the ground, and, where faults are discovered, suggesting corrective measures. The following notes on the organization and operation of this field service force are based on an interview by *Engineering News-Record's* representative with J. H. Jowett, vice-president, and other officials of the Ingersoll-Rand Co. The organization's creed was expressed tersely by Mr. Jowett in these words: "The interest of this company has not ceased with the selling of its apparatus—it is equally concerned with its subsequent performance."

The company has headquarters in New York City and branch offices in 65 other cities, covering not only the United States, Mexico and Canada but Europe, Australia, Africa, South America, Asia, and the East. To the more important branch offices one or more field service men are assigned. Their duty is to follow carefully what the tools are doing in the hands of their purchasers, and as a check on their activities some of the company's executive officers and technical experts make periodic surveys involving extended tours which enable local situations to be studied at first hand.



WALL CHART OF APPROVED PRACTICE

For the field service force only men with special qualifications are chosen. Obviously, they must have a background of practical experience in tunnels, mines, quarries and rock work generally. They must also possess a thorough knowledge of the design, construction, and the use of the equipment which it is their duty to inspect, and, finally, they must be temperamentally equipped for the work, which calls for tact and the ability to win the confidence of the men on the job with whom they deal. They must not be averse to travel, as their duties require them to be constantly on the move from one job to another. Their sense of observation must be developed to a high degree so that both the large and small mistakes in operating methods or equipment use may be noted and corrected. A type of man must be selected for this service who can talk to chief engineers, superintendents, or bosses of tunnel shifts in their own language, calling for an experience in which theoretical and practical knowledge of methods and tools are blended.

Recently Mr. Jowett and other members of the Ingersoll-Rand organization made an extended trip through the Western states to survey the work of the field service force. They found on every hand evidence of the educational campaign which their field representatives were conducting for improving the service of drills and other machinery. The following notes cover some of the suggestions which the manufacturer, through his field service men, is offering to equipment users:

Practical Suggestions on Drill Use

Regular Inspection—For the efficient operation of the rock drill the principle of the "stitch in time" is vital. Drill users are urged by the manufacturer to carry their machines back from the heading to some convenient point underground at the end of every shift, so that the tools can be examined, overhauled, cleaned, and oiled for service on the next shift. By following this practice minor repairs and adjustments can be made and the drill kept in service for long periods without having any serious accident occur. The expense involved, the manufacturer points out, is trifling compared with that entailed when drills must be taken all the way up to the surface and there turned over to the repair shops. In other words, frequent inspection underground offsets a rather common tendency on the part of the drrill-runner to carry on with a defective or limping tool until the machine is put out of commission because of a really serious breakdown.

Lubrication—One of the most important operating points stressed by the field service men is frequent and proper lubrication of rock drills. While the construction of the modern rock drill is extremely rugged, the service it is called upon to perform involves a great amount of wear and tear on the moving parts of the machine. Sometimes a service man encounters the spectacle of an operator endeavoring to loosen up a stuck drill with a flow of profanity and a sledge hammer. These are the men to whom the message of frequent lubrication must be carried. The remedy will often be found in the formula: "Feed the machine a little grease at a time, but often. When in trouble, lubricate!" Experience has shown that in most of the cases when steel is stuck the filling of the back and front oil pockets and opening up the throttle will free the steel.

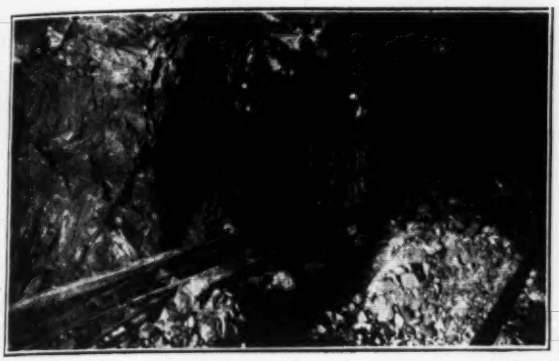
It has been found by experiments covering a long term of years that "liquid grease" is especially suited to

the needs of rock drills. The company has made a careful study of lubricants and furnishes to purchasers of its equipment a list of approved greases and oils, which is printed on tags attached to the lubricating pockets of each machine when shipped from the factory. These printed instructions are followed up in the field by the company's service men.

The Scrap Box—One of the first points of inspection by the service men arriving on a new job is the scrap box. Here valuable information is usually secured. In the manufacture of rock drills standardization is carried to great

service men consists in impressing on the user the importance, first, of selecting drill steels of the proper quality and then outlining, for the benefit of the blacksmith on the job, the best methods or equipment for sharpening and tempering bits and forming shanks. By reason of its long experience in rock drilling, the company is in a position to suggest the most effective procedure, so far as equipment goes, in tunneling and mining operations, so that by following the hints of the field service men there is no reason for wasting time on cut-and-try methods. Often a suggestion regarding the type of bit best adapted

drill and prolonging its life. It is not enough for the bits to be properly sharpened. One of the big sources of trouble lies in steels with improperly formed shanks. Defective shanks have been found to be the most common cause of piston breakage. Among the principal causes of trouble are shanks with ends not squared off true or with diameters too small to insure a snug fit in the rotation sleeve or chuck. In either case the piston strikes on the edge of the shank end, instead of distributing the full force of the blow over the entire area of the shank. The same effect is produced by a worn front chuck bush-



"THE WORK IN THE HEADING MUST BE CLOSELY CO-ORDINATED WITH THAT IN THE BLACKSMITH SHOP"

lengths and component parts are all made interchangeable. Sound drill parts are sometimes scrapped when they still have much working life left in them. This is, of course, due to a lack of knowledge on the part of the repair man. The service men emphasize the importance of much care in the repair of machines and show the repair man how to determine when parts are worn out. Frequently 20 per cent saving in tool upkeep cost has been made in this way. Mr. Jowett emphasized the company's appreciation of the helpful and constructive suggestions made from time to time by drill fitters, i.e., the men in charge of rock drill repairs, who from their every-day contact with repair problems often suggest simple modifications in design or construction which help to reduce the cost of maintainance.

Repair Part Stocks—In addition to their advice regarding the salvage and re-use of discarded parts, the service men aid drill users in determining the proper size and character of their repair part stocks. Owners of drills sometimes make the mistake of either understocking or overstocking with repair parts. The carrying of large quantities of reserve equipment involves considerable overhead expense, insurance, and the cost of maintaining storage facilities. Recognizing these conditions, the Ingersoll-Rand Co. has devised a system by which it carries a proper supply of repair parts at its main plant and outlying branches. Such stocks are kept up in accordance with an intimate knowledge of the changing needs of each customer. Under the plan the customer can be supplied at short notice and he need not carry a large supply on his own shelves. Production is regulated to prevent an oversupply of parts which may be superseded by new models.

Drill Steel—Perhaps one of the most important duties of the company's field to the particular rock encountered has resulted in greatly increased drilling progress.

The work in the heading must be closely co-ordinated with that in the blacksmith shop. For example, in forging bits and shanks on hammer drill steel care must be taken not to overheat the steel, as it may become decarbonized and thus spoiled. Too high a forging heat results in excessive breakage of bits, shanks, and steels. Where possible an oil furnace is recommended for heating steel prior to sharpening, while the use of a drill-sharpening machine, operated by compressed air, speeds up the work and produces bits of uniform quality and size.

The company's representatives always impress upon drill sharpeners the desirability of allowing the steels, after they are forged on the bit end and on the shank end, to cool off before reheating for tempering purposes. With the company's Swedish drill steel forging heats should not be less than 1,850 nor more than 1,950 deg. F. If after tempering, the bits are too hard the edges may break or chip off and if too soft they flatten out. For medium hard rock, field service men suggest heating steel to about 1,450 deg. F. (cherry red) for the tempering process. In some cases where it has been found impossible to harden the bits properly, the trouble has been due to the presence of alkali in the water for quenching the bit. In such cases the suggestion is made that rain water be used in a tank provided with a water jacket for cooling. Where very hard bits are required, the tempering may be done in a brine solution. All hammer drill shanks should be tempered in oil at a dipping temperature when quenched of 1,450 deg. F. (cherry red).

Shanks—The company's inspectors lay great stress on the necessity for correct drill steels as a means of obtaining the maximum work from the ing, which allows the steel to swing out of line with the direction of piston stroke. Any of these conditions, of course, concentrates the full force of the blow on a comparatively small area of the piston, resulting in excessive strain often followed by breakage. The field service men, during their visits, always make it a point to inspect drill steel shanks and to instruct blacksmiths in their proper formation and treatment. Stress is laid on having the shank dimensions correct, and in squaring off the ends the blacksmith is urged not to depend on his eye but to test the trueness of the surface with a T-square. Each shop is provided with wall charts outlining recommended practice as shown by sketches and explanatory text. As an aid in securing good results, the field service men supply the drill sharpeners with gages which show whether the shank is the right length and whether the hole (where hollow steel is used) is centered and of the correct size. Gages also are supplied to determine when a rotation sleeve or chuck is worn to the point where it should not be used further.

Holes for Water Tube—An additional important point in the formation of drill steel shanks for water-feed drills is to make sure that the hole in the steel is large enough to receive the water tube. If the shank is too soft the end will upset and cut off the water tube, and trouble also will be caused in getting the steel out of the chuck. The instructions of the field service men, therefore, include gaging the hole in the shank so that a steel may never be sent underground with the hole in the steel improperly formed. This is an important point, as the basic principle of the modern rock drill is the expulsion of the rock cuttings by a flow of water carried under pressure through the hollow drill steel. To insure proper and uniform punching of hollow drill steel a mechanical punch is manufactured

either for attachment to a drill steel sharpener or as an independent unit.

CONCLUSION

The foregoing notes indicate some of the points covered by the field service men during their visits of inspection. This is one manufacturer's conception of service to the users of his product. Back of the plan lies a realization that, in the end, the interests of both maker and user of equipment are identical—getting the most work done at the least cost.

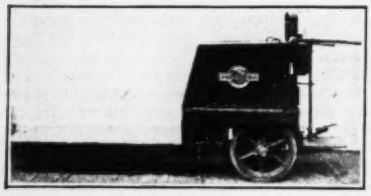
Business Notes

BLAW-KNOX CO., Pittsburgh, announces the opening of a Buffalo, N. Y., office at 622 Genesee Building. J. C. McQuide has been transferred from the Pittsburgh organization as manager of the new branch, which will serve northern and western New York and adjacent territory in connection with the company's road-building machinery, clamshell buckets, forms, sectional steel buildings and structural steel.

Equipment and Materials

Elevating Platform Truck

Announcement is made by the Crescent Truck Co., Lebanon, Pa., of a new elevating-platform truck operated by an electric storage battery and having a pay load capacity of 4,000 lb. The truck is designed for use in factory aisles, at docks, and on warehouse floors, where the load to be moved is



placed on skids under which the truck platform is projected and raised 4½ in., lifting the skid clear of the floor. The overall dimensions of the truck are: Length, 108 in., width, 39 in., and height, 43 in. The wheel base is 58 in. and the load platform dimensions 54 x 26 in. In its lowered position the platform top is 11½ in. above floor level.

The machine has a two-wheel drive, a four-wheel gear and speeds of 6 miles per hour light and 4½ to 5 miles per hour loaded. Separate motors are provided for propelling the truck and raising the platform.

Publications from the Construction Industry

Portable Hoists — SULLIVAN MACHINERY CO., Chicago, has published two new bulletins on its single-drum and double-drum portable hoists for scraper loading.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Canadian Building Permits Decline During September

Total Value At End Of Third Quarter 8 Per Cent Below Corresponding Period In 1922

The value of building permits issued in Canada during the first nine months of this year showed a decline of eight per cent as compared with the corresponding period of 1922, and an increase of 21 per cent over the first nine months of 1921. The total for 1923 was $105,625,554; for 1922, $115,113,336, and for 1921, $86,970,449.

The value of the permits issued in September showed a slight decline as compared with August and there was also a small decrease as compared with September of last year. According to reports from 56 cities the estimated cost of building work during September was $10,485,613, while in August it stood at $11,541,593, and in September, 1922 at $11,424,119. There was, therefore, a reduction of $1,055,980 or 9.1 per cent in the former and of $938,506 or 8.2 per cent in the latter comparison.

Forty-seven cities furnished detailed statements showing that they had issued nearly 1,200 permits for dwellings at a proposed cost of approximately $5,000,000. Some 2,900 permits were issued for other buildings at an estimated valuation of over $4,800,000. The construction of several buildings is frequently authorized by a single permit; the number of buildings to be erected, therefore, would be larger than appears from the number of permits issued.

FOUR PROVINCES GAIN

Nova Scotia, New Brunswick, Quebec and Alberta showed increases in the value of permits issued as compared with August, 1923. The largest actual gain of $882,752 or 35.3 per cent was recorded in Quebec, while Nova Scotia with a gain of $75,630 or 275.8 per cent, registered the most pronounced proportional increase. Of the declines reported in the remaining provinces, those of $1,437,093 or 55.1 per cent in British Columbia and of $720,943 or 13.3 per cent in Ontario were most noteworthy.

In comparison with the returns for September, 1922, Quebec, Alberta and British Columbia registered increases in prospective building. Quebec, with a gain of $444,507 or 15.1 per cent, showed the greatest increase. The heaviest loss of $801,581 or 14.6 per cent, occurred in Ontario, but that in Manitoba of $324,115 or 38.2 per cent was also pronounced.

Thirteen important cities showed gains in September building permits.

In preparation — "The Business Situation as Shown by Industrial Expansion," and "Water-Works Installation in 1922 and 1923."

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 239 to 252, are the following:

Hotel, Tacoma, Wash., Citizens Hotel Corp., $1,500,000.

High School, Hartford, Conn., $1,200,000.

Pulp mill and wharf, Cap Rouge, Que., St. Regis Paper Co., Ltd., $4,000,000.

Dam, Lake Cushman, Wash., Comrs. Light & Water, Tacoma, $1,250,000.

Channel, Pueblo, Colo., Pueblo Conservancy Dist., $4,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News pp. 239 to 252, are the following:

Apartment, New York, N. Y., Sherman Elwood Building Corp., $1,110,000.

Bridge sub-structure, San Francisco, Calif., to Healy-Tibbitts Constr. Co., $1,192,484.

Lock, Point Marion, Pa., U. S. Engineers Office, $750,000.

School, Brooklyn, N. Y., to G. F. Driscoll, $995,995.

British Metals Prices Advanced

The recent tendency in British wholesale prices is upward, particularly in textiles, food products and non-ferrous metals, according to reports received by the U. S. Bureau of Foreign and Domestic Commerce. The advance in metals, particularly, is taken as an indication of improved industrial demand, since continental competition has been held partially responsible for increased unemployment in the United Kingdom.

That British metals prices have paralleled American quotations, in several instances, is shown by the accompanying table.

Electrolytic copper was exactly the same price in Manchester, England, on Sept. 28, as in New York warehouses. Spelter, on the same date, was a small fraction of a cent higher in Swansea, England, than in New York. Brass tubing, however, was ¼c. per lb. higher in New York than in Manchester.

Pig iron, fabricated steel and lead were somewhat higher in the American warehouses, compared with the English quotations. Copper tubing, however, was over 1c. per lb. higher in Manchester than in New York, on the same date.

COMPARATIVE METALS PRICES, SEPT. 28, 1923

	U. S. A.		England	
Copper, electrolytic, per lb.	New York	$0.14	Manchester,	$0.14
Lead, per lb.	New York,	0.075	Manchester,	0.0548
Spelter, per lb.	New York,	0.06875	Swansea,	0.06875
Pig iron, basic, per gross ton	Pittsburgh,	26.90	Lincolnshire,	21.15
Steel structurals, channels and angles, per lb.	New York,	0.0364	N. E. Coast,	0.1087
Steel bars, per lb.	New York,	0.0354	Manchester,	0.0203
Steel tank plates, per lb.	New York,	0.0364	Midlands,	0.0203
Steel hoops, per lb.	New York,	0.0519	Sheffield,	0.02538
Copper tubing, per lb. (base)	New York,	0.245	Manchester,	0.25585
Brass tubing, per lb. (base)	New York,	0.23	Manchester,	0.22743

Value Of October Contracts 17 Per Cent Heavier Than For Same Month Last Year

Falling Off of 7 Per Cent Compared With September—Water-Works, Industrial and U. S. Government Construction Gained

Contracts awarded on large engineering construction projects during October totaled $161,276,000, a gain of nearly 17 per cent, compared with $137,877,000 for the corresponding period in 1922. The October total, however, represents a decrease of about 7 per cent, compared with $173,072,000 for September.

Minimum costs observed in *Engineering News-Record* on each class of construction are as follows: Water-Works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Of the $161,276,000 a total of $3,530,000 represented Canadian awards which fell off heavily from the September level.

All classes of construction fell off during October with the exception of water-works, industrial building and Federal Government projects. Water-works awards gained 26 per cent in total money value during the month, while Federal Government construction increased nearly 16 per cent. Industrial lettings, totaling $48,985,000, were over three times greater than those for the preceding month.

Among the large projects awarded during October were the following: A power station at Kearny, N. J., $20,000,000; addition to plate glass factory at Ottawa, Ill., $5,000,000; silk plant at Jacksonville, Tenn., $4,000,000; 25 mi. conduit, Portland, Ore., $2,571,404; hotel at Chicago, Ill., $2,250,000; hospital at Nashville, Tenn., $2,000,000.

The actual physical volume of construction represented by October contracts is exactly the same as that of October, 1922; 17 per cent heavier than for the corresponding period in 1921 and 74 per cent above the volume of October, 1920, lettings.

Business Briefs

Call money easy but firmer at 4½@5 per cent.

Time money remains dull with all loans at 5@5½.

Record freight movement occurred on Oct. 17, when railroads moved more cars, both loaded and empty, than ever before on any one day in history of American railroads.

Planning to avoid a building crisis, the American Construction Council is urging that, where possible, all repairs and alterations be done this winter so as to avoid delays when the construction takes on a new impetus in the spring.

Engineering News-Record Construction Cost Index Number

November, 1923	220.90
October, 1923	220.30
November, 1922	188.60
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number increased 0.6 points since last month, owing to slight advance in lumber. Prices of other basic building materials remained unchanged during the month. The average rate for common labor is still 54c. Thus, general construction cost is 17 per cent higher than one year ago and 19 per cent under the peak; it is 121 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly		
October, 1923	(*4 issues of E. N.-R.*)	127
September, 1923	(*4 issues of E. N.-R.*)	137
October, 1922	(*4 issues of E. N.-R.*)	127
1913		100
Yearly		
1922 (entire year)		130
1921 (entire year)		88
1920 (entire year)		91
1913		100

Engineering News-Record's Construction Volume Index Number is 127 for the month of October, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 127 for October, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING OCTOBER, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Waterworks	$187,000	$125,000	$15,000	$184,000	$409,000	$2,592,000	$3,512,000	$124,000	$3,636,000
Sewers	.....	2,114,000	300,000	1,345,000	615,000	408,000	4,782,000	314,000	5,096,000
Bridges	27,000	587,000	50,000	306,000	538,000	285,000	1,793,000	632,000	2,425,000
Excavations, drainage and irrigation	.....	.....	205,000	31,000	405,000	208,000	849,000	25,000	874,000
Streets and roads	994,000	5,101,000	4,911,000	5,097,000	6,672,000	3,817,000	26,592,000	1,552,000	28,144,000
Industrial works	905,000	22,670,000	1,476,000	19,250,000	1,088,000	3,546,000	48,935,000	50,000	48,985,000
Buildings	2,335,000	21,421,000	7,611,000	10,076,000	4,964,000	13,031,000	59,438,000	550,000	59,988,000
Federal Government	216,000	978,000	3,722,000	534,000	40,000	388,000	5,878,000	.....	5,878,000
Unclassified	294,000	2,005,000	145,000	1,750,000	1,193,000	580,000	5,967,000	283,000	6,250,000
October, 1923	$4,958,000	$55,001,000	$18,435,000	$38,573,000	$15,924,000	$24,855,000	$157,746,000	$3,530,000	$161,276,000
September, 1923	6,585,000	40,893,000	20,757,000	39,116,000	32,055,000	27,534,000	166,940,000	6,132,000	173,072,000
August, 1923	4,308,000	30,933,000	11,974,000	34,425,000	24,962,000	21,555,000	128,157,000	13,442,000	141,599,000
Total 3 months	$15,851,000	$126,827,000	$51,166,000	$112,114,000	$72,941,000	$73,944,000	$452,843,000	$23,104,000	$475,947,000

Labor Rates and Conditions Throughout the Country

Record car loadings and an active retail trade throughout the country, offer somewhat of a contrast to the recent falling off in production of textiles and metals. Although the Japanese demand has stimulated the building materials market, industrial activity, generally, is uncertain and there has been some curtailment in employment.

The principal wage controversies now awaiting adjustment are among foundry, clothing and railroad workers and derrickmen. A slight rise in living costs, due to higher food and clothing prices, tends to further complicate the wage situation. Rents of wage earners' houses are higher at present, than at any time during the last nine years, and are still rising, according to a nation-wide survey conducted by the National Industrial Conference Board.

The average rate paid common laborers (pick and shovel men) in construction operations, remains at 54c., the same as for the last four months; the June rate being 53c. per hour, according to *Engineering News-Record* figures. Local conditions are as follows:

Baltimore—Scarcity of structural iron workers. Conditions among common laborers nearing normal.

Boston—Labor plentiful in all trades.

Detroit—Conditions normal. Labor supply a little more plentiful.

Minneapolis—Wages slightly lower in brick and tile plants.

CURRENT BUILDING TRADES WAGE RATES PER HOUR
(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	$0.50	.....	$0.75	$0.50@.55
Baltimore	1.50	+1.00@1.12½	.90@1.12½	.87½	$0.65	.80@1.00	.50@.50
Birmingham	1.00	1.00	.50@1.00	.30@.40	.....	1.25	.50@.40
Boston	1.25	1.00@1.05	1.25@1.35	.82½	1.05	1.12½	+.00@.75
Cincinnati	1.25	1.05	1.05	.82½	1.05	1.05	+.50
Chicago	1.25	1.15	1.00@1.25	.88½	1.10	1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.10	.87½
Dallas	1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	1.00	1.00@1.25	.87½	1.00	1.07½	.35@.60
Los Angeles	1.25	87½@1.00	.87½@1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	—.90	.65	.50	.35	.50	.65	—.30
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1.50	1.25	1.25@1.50	1.00	1.00	1.25	.50@.75
Philadelphia	1.50	1.12½	1.02½	.70@1.00	1.00	1.10@1.12½	.45@.50
Pittsburgh	1.40	1.20	1.12½	1.00	1.12½	1.25	.70
St. Louis	+1.75	1.50	1.25@1.37½	1.25	1.25	1.25@1.50	.45@.100
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.25	1.00	1.00@1.12½	.93¾	1.00@1.12½	1.12½	.56¼@.62½

Montreal—Slight scarcity of structural iron workers; plenty of other crafts.

New Orleans—Plenty of labor, skilled and unskilled. Carpenters and plasterers now on strike, demanding increase in wage scale. Contractors, however, have refused to grant demands.

New York—The only wage controversy developing during the last month was a strike of marble carvers, cutters and setters. The marble workers have demanded $11 per day as against $10, which they agreed to accept on May 1.

Philadelphia—Supply of labor equal to demand.

St. Louis—Carpenters wage rate, $1.75 per hour, effective Nov. 1, against $1.50 one month ago. Building and Common Laborers' District Council planning to demand increase of 20c. per hour for 3,000 members, effective March 1. All classes of common laborers affected except plumbers' helpers, who received increase Oct. 1.

San Francisco—New building projects dropped off somewhat; building trades mechanics, however, all busy completing old contracts.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Market slow in Birmingham district despite low price of $23 per gross ton for No. 2 foundry iron. Several thousand tons of foreign iron received during week. Average price about $1 below last month and $5 per ton under year ago.

Railway Supplies—Standard rails, $43 per ton at Birmingham and Pittsburgh mills; light rails higher in St. Louis. Ties higher in Chicago. Railroad steel requirements heavy, particularly in plates.

Pipe—Demand active in wrought pipe; no change in discounts. Cast-iron pipe slightly lower in Chicago and San Francisco. Sewer pipe advanced somewhat in Boston.

Road and Paving Materials—Few changes in road oil and asphalt prices since last month. Mexican asphalt up 50c. per ton in Boston and down about the same amount in Detroit. Road oils lower in St. Louis. Gains in Texas and Wyoming crude oil output offset decline in California. Paving stone higher in Chicago, Boston and Philadelphia; wood blocks up in Boston and Chicago.

Sand, Gravel and Crushed Stone—Sand advanced 5c. per cu.yd. in Dallas and Cincinnati. Crushed stone, however, dropped 5c. in Boston and gravel 15c. per cu.yd. in Cincinnati during month. Changes due to local labor and transportation conditions.

Lime—Hydrated finishing, advanced 25c. in Birmingham, 50c. in Boston, $2 in Atlanta and $3.50 per ton in Dallas; Detroit reports decline of $1 per ton. Hydrated common, up 25c. in Birmingham, $1 in Boston and $1.50 per ton in Atlanta; down $1 in Detroit. Lump finishing, higher in Boston, Birmingham and Atlanta. Common lump, advanced 10c. in Atlanta, 15c. in Birmingham and Boston and 25c. per bbl. in Dallas; dropped 50c. in Montreal and $1 per ton in Detroit.

Cement—Mill prices firm and unchanged. Very little fluctuation at f.o.b. points. Birmingham reports rise of 10c. and Boston, 12c. per bbl., against declines of 20c. in Dallas and 40c. per bbl. in Atlanta, during month.

Structural Steel—October steel demand showed improvement over preceding month. Steel pipe, sheets, tin plate and nails most active items in present market. Plates and shapes still at $2.50 base; bars, $2.40 per 100 lb., with few quotations under that figure. Railroad and ship plates form bulk of steel plate demand; structural material quiet.

Brick and Hollow Tile—Common brick, wholesale, at dock, New York, $19@$20, against $20, one month ago and $14@$15.50 per M. one year ago. Drop of 50c.@$1 in Birmingham, $1 in Minneapolis and $2 per M. in Dallas. Boston quotes rise of $2 per M. Imported brick not penetrating further than eastern seaboard. Hollow tile slightly lower in Minneapolis, Cleveland and Dallas, owing to lighter demand and lower fuel prices.

Lumber—Shipments gain, despite slight falling off in production and new business. West Coast Lumbermens' Association report sales of 27,246,902 ft. b.m. for export during week of Oct. 25. Pine timbers advanced $1 in New York, $2.50 in Dallas and from $2 to $4 per M. ft. in Boston; Chicago reports decline of $1, Birmingham $2, Detroit and Philadelphia $2.50 per M. ft., in month. Douglas fir rose 50c. in Seattle and $2 per M. ft. in Detroit; dropped $3 in Philadelphia and $6 in Denver since Oct. 4. Hemlock up $2 in Boston and $8 in Montreal; down $3 in Philadelphia. Spruce advanced $2 per M. ft. in Boston.

Explosives—Slight decline in 60 per cent gelatin dynamite in Dallas; no other changes.

Scrap—No. 1 machinery cast and heavy melting steel down $1 in New York. Stove plate dropped 50c. in St. Louis. Slight advance, however, in railroad malleable cast in latter city.

Linseed Oil—Raw oil, 98c., against 95c. per gal. (5 bbl. lots) f.o.b. New York, one month ago. Advance of 4c. per gal. reported in San Francisco, during week. No changes in nineteen other cities.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Nov. 1	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$26.05**	$31.55
Northern Basic	*25.00*	33.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*25.00*	34.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**29.00**	36.27
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	23.00	27.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*24.25*	33.64
Virginia No. 2 (silicon 2.25 @ 2.75)	*28.17*	37.17
Basic	*25.00*	29.50
Gray Forge	25.00	32.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*25.50*	31.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*28.00*	33.50
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	26.77	33.50
Basic	26.77	30.00
Bessemer	27.77	32.50

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15.00	$11.50	16@16.50
Stove plate	12.00	12.00	*16.00*
No. 1 machinery cast	*16.00*	16.50	19.50@20
Machine shop turnings	8.00	4.00	12.50@13.50
Cast borings	9.00	5.50	14.00
Railroad malleable cast	15.00	12.50	**21.00**
Re-rolling rails	13.00	13.00	21.50@22
Re-laying rails	.....	30.00	28.00@31
Heavy melting steel	*11.00*	16.00	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Nov. 1	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	.....	$43.00	$43.00
Standard openhearth rails	43.00	43.00	*$43.00*	43.00	43.00
Light rails, 8 to 10 lb.	43@45	45@47	2.00*	43.00	43@45
Light rails, 12 to 14 lb.	43@45	45@47	2.00*	43.00	43@45
Light rails, 25 to 45 lb.	43@45	45@47	2.00*	43.00	43@45
Rerolled Rails	*37@39*	28@32	.....	.....	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	**$1.70**	**$1.90**
Chicago, Hardwood and Red Oak	**1.35@1.45**	**1.50@1.70**
Chicago....Empty Cell Creosoting (add'l)	**.50**	**.60**
San Francisco..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.60
St. Louis (creosoted) (zinc treated)	**1.70**	**2.05**
St. Louis, Red Oak, plain	1.20	1.50
St. Louis, Sap pine-cypress	1.05	1.35

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Nov. 1	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$3.15	$2.75@3.00	$3.00	$4.00	$5.00	$3.75‡
Track bolts	4@4.25	3.85@4.50	4.00	5.05	6.20	4.57
Standard section angle bars	2.75	2.75	2.75	4.00	4.00	3.20

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Nov. 1	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$53.00	$68.60	$60.30	*60.20@64.20*	$61.60	*$65.00*
6 in. and over	49.00	63.60	55.30	*57.20@60.20*	57.60	*61.00*

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Nov. 1	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$45.00	$50.00	$62.50	.....	$73.00
4	55.00	55.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	85.00	100.00	97.75	108.00
6	105.00	105.00	85.00	175.00	127.50	133.00
8	170.00	170.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.105	.....	.....	$0.15	$0.12	.....
4	.....	.105	$0.11	$0.1175	.15	.15	$0.15
5	.....	.1575	.1375	.....	.23	.18	.18
6	$0.24	.1575	.165	.1645	.23	.21	.21
8	.38	.245	.26	.26	.35	.30	.325
10	.57	.3675	.338	.364	.53	.42	.476
12	.72	.4725	.442	.468	.68	.54	.612
15	1.13†	.63	.65	.78†	.90	.90	.884
18	1.65†	.875	.85	1.092†	1.25	1.32	1.153
20	1.98†	1.05	1.125	.....	1.50	.....	.....
22	2.64†	1.40	1.375	1.456†	2.00	.....	1.564
24	2.97†	1.575	1.625	1.872†	2.25	2.16	2.04
27	4.81†	2.795	....	2.95†	4.69†	3.00	3.34
30	5.33†	3.096	....	3.65†	5.94†	3.60	4.06
33	6.93†	4.14	....	4.45†	6.88†	.....	4.99
36	7.91†	4.715	....	4.80†	7.50†	.....	5.42

	3	5	8	12	24	36
Boston	**$0.131**	**$0.202**	**$0.320**	**$0.612**	**$2.05†**	**$6.15†**
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.36	.72†	2.60†	.....
Los Angeles	.13	.165	.275	.475	1.65	.....
New Orleans	.145*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	.105*	.16*	.27	.455	1.75	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	.117	.175	.273	.5265	1.755	3.9975
Kansas City, Mo.	.....	.....	.....	.....	.....	.....
Philadelphia	.12	.18	.28	.54	1.80	5.2275

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Nov. 1	One Year Ago
New York, 45% asphalt.....(at terminal)	$0.053	$0.06
New York, 65% asphalt.....(at terminal)	052	.06
New York, binder.....(at terminal)	06	.0675
New York, flux.....(at terminal)	06	.065
New York, liquid asphalt....(at terminal)	.048	.07
St. Louis, 50@60% asphalt	*.055*	.045
St. Louis, 40@50% asphalt	*.053*	.....
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.0495	.10
Dallas, 55% asphalt	.0455	.13
Dallas, binder	.061	.15
San Francisco, binder, per ton	9.50*	13.00*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00*	$15.00†
Boston (*Mexican*)	22.00	18.00
Chicago (*Stanolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	24.75	20.50
Denver (*California*)	24.00	.....
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.45	19.10
St. Louis (*Mexican*)	29.50	24.50
Baltimore (*Standard Oil*)	18.00	14.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.00	23.50
Detroit (*Mexican*)	*22.00*	*18.00*
Cincinnati (*Kentucky Rock*)	17.50	13.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	*19.00*	16.00
Kansas City (*Texas*)	.....	.....
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17.00	11.00

*F.o.b. Bayonne, N. J.
†F.o.b. Marcus Hook, Pa.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$138.00 per M.
Chicago	About 4x8x4 dressed	3.60 per sq.yd.
	About 4x8x4 common	3.20 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	130.00 per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	106.00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4"x8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	*3.05* per sq.yd.
	4x8x4 common	*2.90* per sq.yd.
Kansas City	Granite	..... per sq.yd.
Philadelphia	Granite	3.75@4.50 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide....No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.45 per lin.ft. *Chicago*: 5 x 18 in., $3.35 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.58
New York (*delivered*)	3½	16	2.79
Boston	3½	16	2.70
Chicago	4	16	3.50
Chicago	3½	16	3.50
St. Louis	3½	16	2.55
St. Louis	4	16	2.90
Seattle	4	16	Off market
Minneapolis	3½	16	2.70
Atlanta	3½	16	1.90
New Orleans	3	16	2.50
New Orleans	3½	16	2.81
New Orleans	4	16	3.15
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	.....
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Nov. 1	Gravel 1½ In. One Year Ago	Gravel ¾ In. Nov. 1	Gravel ¾ In. One Year Ago	Sand Nov. 1	Sand One Year Ago
New York	$1.75	$2.00	$1.75	$2.00	$1.25	$1.00
Denver	1.90	1.75	1.90	1.75	1.00	0.75*
Chicago	2.00	2.25	2.00	2.25	2.00	2.25
St. Louis	2.30	1.40†	2.35	1.45†	2.10	1.20†
Seattle	1.25	1.00	1.25	1.00	1.25	1.00
Dallas	2.38	2.25	2.38	2.25	2.00	2.25
Minneapolis	1.85*	1.75	1.85*	1.75	1.25	1.00
Cincinnati	*1.35**	1.40	*1.35*†	1.40	1.35*	1.15
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.40	.....	1.40	.....	1.10	.....
New Orleans	2.85	2.85	2.85	2.85	1.25	1.35
Los Angeles	2.50	.....	2.50	.....	1.75	.....
Atlanta	1.85†	2.00†	1.85†	2.00†	1.24†	1.35†
Detroit	1.62	2@2.25	1.62	2@2.25	2.02½	2.00
Baltimore	1.40	1.40	1.60	1.60	0.70†	0.70*†
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)	.....	.....	.....	.....	1.30†	1.20†
Philadelphia	2.00†	1.70	2.00†	1.75	1.50†	1.65
Kansas City	.....	2.00	.....	2.00	.....	0.66*†

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Nov. 1	1½ In. One Year Ago	¾ In. Nov. 1	¾ In. One Year Ago
New York	$1.65	$1.65	$1.75	$1.75
Chicago	2.00	2.25	2.00	2.25
St. Louis	1.75	2.10	1.90	2.20
Dallas	2.83	1.65	2.83	1.65
San Francisco	2.15	2.25	2.15	2.25
Boston,	*1.55*	.....	*1.55*	.....
Minneapolis	1.85	2.00	2.00	2.25
Kansas City	.....	2.00	.....	2.00
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.10*	2.00*	2.10*
Cincinnati	1.65	1.55*	1.65	1.55*
Los Angeles *delivered*	2.75	.....	3.00	.....
Detroit	1.75	1.90@2.00	1.75	1.90@2.00*
Baltimore	2.50	1.70*	2.55	1.60*
Montreal	1.80*	1.50*	1.90*	1.90*
Philadelphia	2.00*	1.75*	2.00*	1.60*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	0.85	0.90	2.50	.....
Birmingham, Ala	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23.20	20.00	1.87½†	1.87½†
Boston	23.00	17.00	4.50*	2.75*
Dallas	23.50	.....	.....	2.00‡
Cincinnati	16.80	14.30	.....	.....
San Francisco	22.00	.....	.....	2.10*
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	.....	.....	2.70*
Detroit	*20.00*	*19.00*	.....	*19.00‡*
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	18.50	.....	2.00†
Baltimore	24.25	17.85	2.55	.....
Montreal	21.00	21.00	.....	2.50‡
Atlanta	25.00	16.00	2.45†	1.60†
New Orleans	.....	.....	2.40†	1.85†
Philadelphia	23.00	16.00	.....	1.24†
Kansas City	.....	.....	.....	.....
Birmingham	14.50	13.75	2.00†	1.80†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80. Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b. exclusive of bags:

	Nov. 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	.....	1.75
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.80	.....
St. Louis (Carney)	2.35	1.75
Birmingham (Magnolia) pozzolan cement	2.10	.....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Nov. 1	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.60
New York, alongside dock to dealers	2.30	2.30	2.30
Jersey City	2.48	2.48	2.73
Boston	2.90	2.78	.....
Chicago	2.20	2.20	2.20
Pittsburgh	2.24	2.24	2.24
Cleveland	2.46	2.46	2.46
Detroit	2.48	2.48	2.47
Indianapolis	2.41	2.41	2.41
Toledo	2.48	2.48	2.48
Milwaukee	2.37	2.37	2.37
Duluth	2.25	2.25	2.14
Peoria	2.41	2.41	2.39
Cedar Rapids	2.48	2.48	2.45
Davenport	2.43	2.43	2.43
St. Louis	2.45	2.45	2.35
San Francisco	2.61	2.63	2.71
New Orleans	2.90	2.90	3.30
Minneapolis	2.50	2.50	2.39
Denver	2.84	2.84	2.85
Seattle	2.90	2.90	2.90
Dallas	*2.05*	2.25	2.25
Atlanta	*2.60*	3.00	2.54
Cincinnati	2.54	2.54	2.51
Los Angeles	3.16	3.16	.....
Baltimore	2.65	2.65	2.90
Birmingham	2.80	2.70	2.40
Kansas City	.....	2.45	2.85
Montreal	2.25	2.25	2.88
Philadelphia	2.96	2.96	2.51
St. Paul	2.50	2.50	2.39

NOTE—Bag: 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.20
Universal, Pa.	2.00	Leeds, Ala.	2.20
Steelton, Minn.	2.06	Hannibal, Mo.	2.10
Fordwick, Va.	2.20	Lehigh Valley District	2.10
Mitchell, Ind.	2.10	Wyandotte, Mich.	2.30
Iola, Kan.	2.10	Alpena, Mich.	2.10
Mason City, Ia.	2.10	Richard City, Tenn.	2.20
La Salle, Ill.	2.10	Kingsport, Tenn.	2.20

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	Warehouse: St. Louis	Warehouse: Dallas	Warehouse: San Francisco
032	22	$0 95	$1 02	$1 24	$1.04	$1 12	$1 21
049	28	1 20	1 30	1 58	1 32	1 38	1 52
068	35	1 47	1 59	1 94	1 62	1 67	1 87
093	45	1 89	2 04	2 50	2 08	2 00	2 42
126	57	2 34	2 53	3 09	2 59	2 55	2 99
153	68	2 79	3 02	3 60	3 08	3 15	.....
180	78	3 20	3 47	5 22	3 64	3 47	.....
245	103	4 22	4 57	4 60	4 66	4 58	.....
287	119	4 88	5 28	6 44	5 39	5 26	6 00
336	138	5 66	6 13	7 39	6 25	6 11	.....
395	160	6 56	7 10	8 67	7.25	7.12	.....
		PAVING					
036P	17	$0 72	$0 78	$0 95	$0 79	$0 76	.....
053P	24	1 02	1 10	1 35	1 12	1 07	.....
072P	31	1 29	1 40	1 71	1 42	1 39	.....
097P	40	1 66	1 80	2 20	1 83	1 90	.....
049R	24	.....	1 10	.....	1 12	1 07	.....
067R	31	.....	1 40	.....	1 42	1 39	.....
089R	40	.....	1 80	.....	1 83	1 90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$21 25	$20 72	$20 00	$25.50
26 "	2.5	22 00	22 50	22 39	19 11	27 58
25 "	3.0	22 00	25 25	24 93	.....	30 71
24 "	3 4	24 00	27 25	27 10	24 09	33 16
22 "	4 33	27 00	31 75	32 27	.....	35 10

*Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	New York	Warehouse, Uncut: Chicago	St. Louis	Dallas	San Francisco
½ and larger..	$2 40	**$2.70**	$3 54	$3 20	$3.35	*$3.38*	$3 65
⅝	2 45	**2 80**	3 59	3 25	3 50	*3 43*	3 75
¾	2 50	**2 90**	3 64	3 30	3 55	*3 48*	3 85
⅞	2 65	**2 95**	3 69	3 45	3 75	*3 63*	4 05
1	2 90	**3 00**	4 04	3 70	4 35	*3 78*	4 65

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	*$2 30*	$3.05	*$3.08*	½	**$2.70**	$3.30	*$3.33*
⅝ in.....	**2 40**	3 10	*3 13*	¾	**3.30**	3.50	*3 48*
⅞	**2 50**	3 15	*3 18*	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Nov. 1	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 4-inch*
New York (del.)	*$22.40@23.65*	$23.65	$16.90@18.55	$46.50	$54 00
New York (at dock)	*19@20*	20.00	14@15.50	.....	.....
Chicago	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon	16@18	16@18	14 00	38@40	40@42.50
Denver, salmon	12.00	12.00	12.00	.....	.....
Dallas	*11.00*	13.10	10.90	33.00	.....
San Francisco	15 00	15.00	15.00	.....	.....
Los Angeles (del.)	15 50	15 50	.....	(not used)	
Boston (del.)	**23.00**	21.00	.....	48.25	56 00
Minneapolis (del.)	*16@18*	17@19	18@19	.....	.....
Kansas City	.....	14 50	14 00	.....	.....
Seattle	15 00	15 00	14 00	55 00	.....
Cincinnati	18@19	17@20	17 00	*42.00*	*45.00*
Montreal	16.50	16.50	16 00	100.00‡	68 00
Detroit (del.)	18.25	18.25	16.50@17.50	38.50	41.50
Baltimore (del.)	21.00	21.00	20.00	40.00	45.00
Atlanta	11 00	11 00	12 00	40.00	45.00
New Orleans	18 75	18 75	15 75	.....	.....
Birmingham	*12.50@14.00*	13@15	12.50	.....	.....
Philadelphia	22.00	22.00	20@28	38.00	46.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	16.00	16.00	16.00	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Nov. 1 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.1179	$0.1230	$0.0724	$0.135	$0.089	$0.108	.....
6x12x12	.1769	.1844	.0996	.....	.122	.156	.....
8x12x12	.2211	.2305	.1358	.23	.162	.244	$0.1968
10x12x12	.....	.....	.1695	.....	.186	.....	.2442
12x12x12	.....	.....	.1937	.....	.232	.....	.3175

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.13	$0.24	.....
Minneapolis (f.o.b. cars)	*.07*	*.18*	*$0.20*
Minneapolis (delivered)	*.075*	*.130*	*.210*
Cincinnati	.0815	.153	....
Kansas City	.....	.....	.....
Denver	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory	.1042	.188	....
New Orleans	.12	.23	.27
Detroit (delivered)	.1145	.2147	.27
Montreal	.115	.225	.30
Baltimore	.125	.27	.....
Atlanta	.102	.175	.....
Dallas	*.110*	.20	.285
Birmingham	.11	.18	.....
Pittsburgh (delivered)	.068	.128	.179
Cleveland	*.08*	*.164*	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Warehouse: Dallas	Warehouse: St. Louis	Warehouse: Chicago	Warehouse: San Francisco
Beams, 3 to 15 in	$2 50	**$3 00**	$3 64	$4 20	$3 45	$3 40	$3.60
Channels, 3 to 15 in	2 50	**3 00**	3 64	4 20	3 45	3 40	3.60
Angles, 3 to 16 in., ¼ in. thick	2 50	**3 00**	3 64	4 20	3 45	3 40	3.60
Tees, 3 in. and larger	2 50	**3 00**	3 64	4 20	3 45	3.40	3.60
Plates, ¼ in. thick and heavier	2 50	**3 00**	3.64	4.30	3 45	3.40	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York — Nov. 1	Warehouse: New York — One Yr. Ago	Warehouse: Chicago	Warehouse: St. Louis	Warehouse: San Francisco	Warehouse: Dallas
½ in. and larger	*$2.75@3.00*	$4.40	$3.85	$3.75	$4.15	$5.00	$4.90
CONE HEAD BOILER							
½ in. and larger	$3.10@3.35	$4.50	$3 95	$3 85	$4.35	**$5.20**	$5.00
⅝ and ¾	3.25@3.50	4.66	4.11	4.00	4.70@4.95	**5.35**	5.15
⅞ and 1	3.50@3.75	4.90	4 35	4.25	4.95@5.10	**5.60**	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00	$3 80	$4 25	**$4 55**	$3.34	$4 95
Cut	.....	4 45	5.80	5.75	3.64	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$9.85	$7.65	$8.00
⅝	7.80	6.30	7.75
¾	7.75	6.15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs *$2.31* per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in l) f.o.b. Philadelphia, l.c.l., **$5.80** per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$67 50
Tar pitch (in 400-lb. bbl.), per 100 lb	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*	38.75
Asphalt felt (light), per ton, f.o.b. plant*	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of *84@85* per cent from standard lists, f.o.b. New York; "A" grade less *86@87* per cent and "B" grade, *88@89* per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$3.00	**$4.45**	*$4.00*	$5.25	$4.59
No. 12	3.10	4.50	*4.05*	5.30	4.64
No. 14	3.20	4.55	*4.10*	5.35	4.69
No. 16	3.40	4.65	*4.20*	**5.45**	4.79
Black					
*Nos. 18 and 20	3.70	5.00	*4.70*	5 60	4 95
*Nos. 22 and 24	3.75	5.05	*4.70*	5 65	5.00
*No. 26	3 80	5.10	*4.75*	5 70	5 05
*No. 28	3.85	5.20	*4.85*	**5 80**	5.15
Galvanized					
No. 10	4.00	5.35	**5 85**	5 50	5.15
No. 12	4 10	5.45	**5 95**	5 60	5.25
No. 14	4 10	5.45	**5 95**	5 75	5.25
Nos. 17 to 21	4 40	5.75	**6.25**	5 90	5.55
Nos. 22 and 24	4 55	5.90	**6 40**	6.05	5.70
*Nos. 25 and 26	4.70	6.05	**6 55**	6 20	5.85
*No. 28	5.00	6.35	**6 85**	6 50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Nov. 1	New York: One Year Ago	Chicago: Oct. 6	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	**$0.98**	$0.93	$1.14	$0.94

WHITE AND RED LEAD—In 100-lb. kegs, base prices in cents per pound:

	Dry		In Oil	
	Nov. 1	1 Yr. Ago	Nov. 1	1 Yr. Ago
Red	14.00	12.75	15.50	14.25
White	14.00	12.75	14.00	12.75

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00
3x10 and 12	40.00	41.00	42.00	45.00
3x14	42.00	42.00	44.00	46.00
4x10 and 12	40.00	41.00	42.00	45.00
4x14	42.00	42.00	44.00	46.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42.00	$44.00	$46.00
6x14	47.00	49.00	51.00
8x10	42.00	44.00	46.00
8x14	47.00	49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$49.00	$50.00	*$44.50*	*$46.50*
3x10 to 10x10	53.00	54.00	*50.50*	*52.50*
3x12 to 12x12	57.00	58.00	*57.50*	*59.50*
3x14 to 14x14	64.00	67.00	*63.50*	*65.50*
3x16 to 16x16	69.00	70.00	*71.50*	*73.50*
3x18 to 18x18	83.00	84.00	*81.50*	*83.50*
4x20 to 20x20	93.00	94.00	.....	.....

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	**$67.00**	.....	**$62.00**	**$62.00**	$85.00	.....
Seattle	.....	**$29.50**	.....	.....	.....	**$29.50**
New Orleans	28.00	.....	.....	.....	31.00	.....
Baltimore	33.50	53.00	53.00	60.00	38.00	53.00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00	.....	.....	.....	.....	*65.00*
Los Angeles	.....	50.00	.....	.....	.....	51.00
Denver	.....	43.25	.....	.....	.....	*48.00*
Minneapolis	42.00	43.75	41.50	.....	44.00	45.75
Atlanta	35.00	.....	.....	.....	39.00	.....
Dallas	**50.00**	.....	.....	.....	**54.75**	.....
Kansas City	.....	.....	.....	.....	.....	.....
Birmingham	30@35	.....	.....	.....	40@45	.....
Philadelphia	*62.00*	*59.00*	*59.00*	**77.00**	*73.00*	*70.00*
Detroit	*43.75*	*49.75*	.....	.....	*56.75*	**52.25**
St. Louis	**44.00**	.....	.....	.....	56.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	**$55.00**	.....	**$52.00**	**$62.00**	.....
Seattle	.....	**$25.00**	.....	.....	**$29.00**
New Orleans	72.00	.....	.....	31.00	.....
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	56.00	50.00	**45.00**	45.00	45.00
Los Angeles	.....	45.00	.....	.....	.....
Denver	.....	34.25	34.25	.....	34.25
Minneapolis	42.00	39.75	39.50	38.25	36.25
Atlanta	19.50	.....	.....	29.00	.....
Dallas	**50.00**	.....	.....	**53.33**	.....
Kansas City	.....	.....	.....	.....	.....
Birmingham	*24@28*	.....	.....	*32@36*	.....
Philadelphia	*33@34*	63.00	46.00	*51.00*	65.00
Detroit	*49.00*	**38.00**	.....	*41.50*	*39.50*
St. Louis	40.00	.....	.....	29.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M.ft. additional.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Nov. 1	One Month Ago	One Year Ago
$2.65	$2.65	$2.50

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft.; ½-in., 6; ⅝-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.15@0.17	New Orleans	$0.17½
New York	.18	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	.18	St. Louis	.19½
San Francisco	.16	Montreal	.22
Atlanta	.18½	Detroit	.20
Denver	15½@17½	Baltimore	.18
Cincinnati	.19	Kansas City	
Dallas	.21	Birmingham	.20½
Philadelphia	.17		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.24	.26
Kansas City	.....	.....
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.2225	.2475
Denver	.2025	.2275
Dallas	.225	.502
Los Angeles	.1975	.2225
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.22
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	4.90@5.00
Soda ash, 58%, in bags, per 100 lb.	1.33@1.51
Chlorine, liquid, cylinders, 100 lb., per lb.	.08½@.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34
Cincinnati	.29	Philadelphia	.32†
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

November 8, 1923

NOV 1 2 1923

Engineering News-Record

An Experiment in Earth Road Construction

By Ben H. Petty

Reconstructing Sixteenth Street Viaduct in Denver

By Elsie Eaves

A Study of Vibration in Francis Type Waterwheels

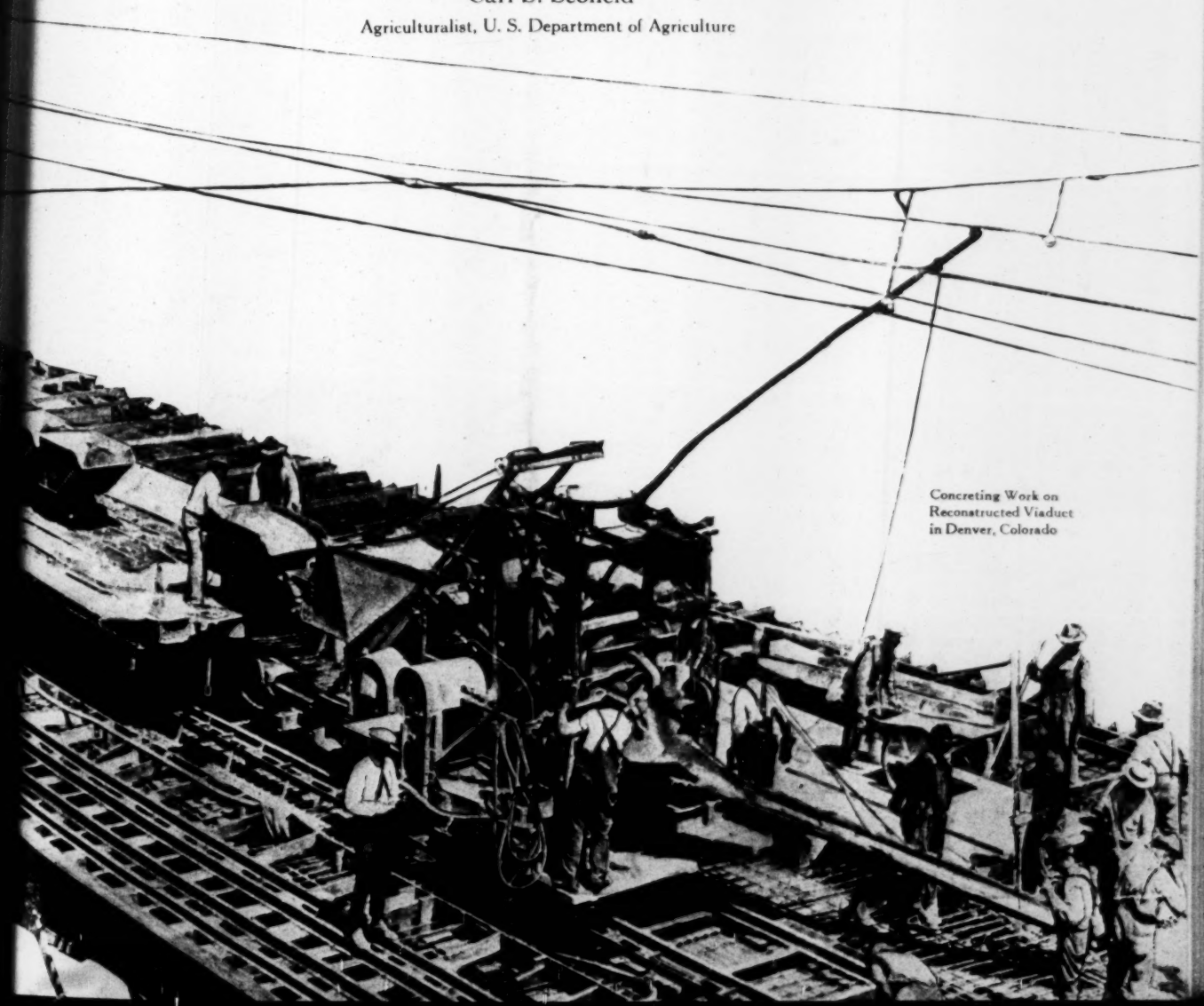
The third article in the series on

Federal Land Reclamation

in this issue treats of AGRICULTURE ON IRRIGATED LANDS *and is contributed by*

Carl S. Scofield

Agriculturalist, U. S. Department of Agriculture



Concreting Work on Reconstructed Viaduct in Denver, Colorado